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ABSTRACT

Drawing on testimony presented at hearings before the Subcommittee on Health and Safety of the House of Representatives conducted between February 28 and June 12, 1984, this staff report addresses the general topic of video display terminals (VDTs) and possible health hazards in the workplace. An introduction presents the history of the development of VDTs and summarizes current scientific knowledge about VDT, with emphasis on the fear of radiation exposure. Figures are used to illustrate both how a VDT works and how VDT radiation is measured. Reproductive hazards from VDTs are discussed, including results of three surveys (Newspaper Guild-Mount Sinai, 9 to 5, and Canadian Scientists) and a proposed study by the National Institute for Occupational Safety and Health (NIOSH). Remarks are also included from (1) witnesses from various labor organizations--9 to 5, the Service Employees International Union, the Communications Workers of America, and the Newspaper Guild--speaking for employees who use VDTs; (2) witnesses representing employers and business equipment manufacturers; and (3) a group of witnesses representing various aspects of the health professions. Findings and conclusions are followed by extensive appendices, which include: a witness list; a synopsis of testimony by various witnesses before the subcommittee; remarks on video display terminals and ELF/VLF (extra low frequency/very low frequency) electromagnetic fields; data on human factors standards for visual display units and the design of work stations, display packaging characteristics, display image characteristics, and lighting and reflectance; and a transcript of a demonstration of instruments for measuring radiation that was presented before the subcommittee by representatives of the American Newspaper Publishers Association. (JB)

[COMMITTEE PRINT]

A STAFF REPORT

ON THE

OVERSIGHT OF OSHA WITH RESPECT TO VIDEO DISPLAY TERMINALS IN THE WORKPLACE

SUBCOMMITTEE ON HEALTH AND SAFETY
COMMITTEE ON EDUCATION AND LABOR
HOUSE OF REPRESENTATIVES
NINETY-NINTH CONGRESS

FIRST SESSION

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JOSEPH M. GAYDOS, *Chairman.*

STAFF REPORT—VIDEO DISPLAY TERMINALS AND POSSIBLE HEALTH HAZARDS

INTRODUCTION

It is estimated that between 10 and 14 million Video Display Terminals (VDTs) are in use in American workplaces, primarily office industries such as banking, insurance, newspapers, and a host of others. What's more, it is expected that within the next decade, about half of all American workers will be using a VDT for at least some portion of the work day.

For those who use or will use the VDT, either at work or at home (as part of a personal computer system), it is considered a time-saving device which provides information quickly and conveniently. For those in the office environment who will be spending several hours each day at a terminal, it can mean something different.

As each generation of new technology has been introduced into the workplace, it has created concerns for those using the new equipment. Some of those concerns are real; others are imagined. Whether real or imaginary, those concerns deserve to be addressed.

In the not too distant past, the manual typewriter became the principal office tool, replacing handwritten material. And, although the manual typewriter was large and cumbersome, it was major improvement. No doubt, however, it did create stress and trauma for many employees who felt threatened by this new technological marvel.

The next step in the chain was the transition from the manual typewriter to the electric typewriter. This transition also caused trauma, resulting in many concerns and complaints. Those who spent long hours at the electric typewriter complained of backaches, tired eyes and tension. There were fears that workers would be judged by how much they produced and, because the electric typewriter was so much faster and easier to use than the manual, more production was expected. An important corollary was the speed and quality of the work produced by electric typewriters.

Today, we have the VDT and many of those same concerns are once again being raised, as well as a few others that were not considered with earlier technology.

Because the VDT is even faster than the electric typewriter, workers fear that there will be closer monitoring of their time and duties and that more will be expected of them. Physical complaints include eye strain, backache, tension headaches and others. Beyond those, however, are the fears among workers that the VDT is producing radiation that could cause problems for users who are pregnant or might result in cataracts.

Because of these concerns and the rapid introduction of VDTs into the workplace, the Subcommittee on Health and Safety con-

ducted extensive hearings which focuses on the possible health concerns of those who spend long hours on VDT tasks.

The hearings began on February 28, 1984, and concluded on June 12, 1984. Witnesses included representatives of various labor organizations, such as 9 to 5, the Service Employees International Union, the Communications Workers of America and the Newspaper Guild, speaking for those employees who use VDTs.

Witnesses also appeared who represented employers and business equipment manufacturers. Included in this group were the American Electronics Association, the Business and Institutional Furniture Manufacturer's Association, American Newspaper Publishers Association, Printing Industries of America, and Computer and Business Equipment Manufacturers Association.

A final group of witnesses, representing various facets of the health professions, also testified. Among these were the National Institute for Occupational Safety and Health (NIOSH), the American College of Obstetricians and Gynecologists and the American Academy of Ophthalmology.

SUMMARY

The introduction of new technology into any workplace has tended to bring forth new concerns by those who would be using the equipment. One part of the problem appears to relate to the method by which the VDT has been introduced into the workplace. In too many cases, there is an inadequate period of adjustment time between the initial decision to install VDTs and the actual date of installation. In other cases, inadequate training is provided for VDT operators who, until just prior to getting this new tool, were using some other form of office machine.

Another part of the problem is that VDTs have been brought into the workplace without any thought as to how they will mesh with existing office machines, office furniture and fixtures, lighting, and other office activities.

Throughout the course of the Subcommittee's hearings, witnesses representing workers as well as those speaking for employers and equipment manfacturers stressed the need for flexibility. Flexibility in VDT design and location, flexibility in fixtures and furnishings, flexibility in lighting and other amenities, and flexibility in work assignments and rest periods and breaks were among the recommendations.

At the same time, however, employee representatives indicated a goal of seeking legislatively mandated standards and/or rules and regulations governing the introduction, placement and use of VDTs.

The Subcommittee believes these two goals are contradictory. Legislatively mandated standards and/or rules and regulations would appear on the surface to be so restrictive as to inhibit the flexibility of employers and employees in getting the best use of VDTs.

It is the Subcommittee's belief that rather than impose legislatively developed and mandated standards and/or rules and regulations, employers and employees are in the best position to deter-

mine what is best in each individual workplace so as to reduce complaints due primarily to ergonomic factors.

In discussing the concerns of VDT operators, the focus inevitably turns to possible radiation hazards, especially for those who will be using VDTs for long periods of time daily or on a regular basis.

The overwhelming body of scientific knowledge at this point in time strongly suggests that there are no problems with regard to radiation exposure from VDTs. Medical professionals have testified that references to reported clusters of reproductive problems are attributable to chance. Those representing obstetricians and gynecologists stated that the variations in kinds of birth defects indicate factors other than VDT radiation as the cause.

VDTs emit low levels of nearly all types of wave energy. Emissions with known health effects are contained behind the glass phosphor shield of the VDT screen. VDTs also generate visible light waves and minute radio frequency waves spanning three subgroups: low frequency, very low frequency and extra low frequency.

Advisory standards for lower frequency radiation have been promulgated by the American Council of Government Industrial Hygienists (ACGIH) and the American National Standards Institute (ANSI). Those advisory standards fall below standards prepared by European agencies.

Neither the ACGIG nor ANSI advisory standards apply to extra low frequency waves and some very low frequency waves. For that reason, the Subcommittee is recommending *additional* radiation studies to determine if any health effects exist from extra low and very low frequency waves.

It is strongly suggested that the National Institute for Occupational Safety and Health or some other recognized scientific testing agency conduct this additional research.

Low level radio frequencies are produced as energy emissions common to many electric appliances, such as hair dryers, electric baseboard heaters and electric typewriter motors in levels which often exceed those on VDTs.

Although current scientific knowledge suggests that there are no adverse health effects from these low and extra low frequency radio waves, further study and research in this area could eliminate, and definitely reduce, any lingering doubts.

VDT's and Radiation

"There is no radiation being emitted by any of these present video display terminals at the present state of the art which could in any way impact on the health of the individual."—Dr. Max Weiss, Radiation Protection Group, Bell Laboratories, before the Subcommittee.

Radiation is typically one of the greatest fears among VDT users. Labor organizations all expressed concerns about radiation which they believe could be emitted from video display terminals in amounts which could cause health hazards, especially birth and reproductive problems, and cataracts.

Representatives of VDT manufacturers, management and the scientific community testified that present equipment emits no radi-

ation that would be considered hazardous to an operator or to anyone working in proximity to a video display terminal.

These varying viewpoints lead to a series of questions about radiation and its relationship to the video display terminal.

There are many parts of the spectrum of radiation energy. Even visible light or the heat in our homes are forms of radiation. All are unavoidable in some quantities in nature, but only certain areas on the spectrum and certain levels within those energy forms are considered hazardous to human beings.

All matter in the universe above the temperature of absolute zero emits radiation on a variety of wavelengths. The term radiation generally refers to electromagnetic waves, i.e., waves with both electric and magnetic components. The entire range of electromagnetic waves, called the electromagnetic spectrum, is illustrated in Figure 1 A rainbow represents the narrow, visible light portion of the spectrum.

Every electromagnetic wave has a number of distinguishing characteristics, including frequency and wave length. Frequency is the number of wave cycles completed in a given period of time, usually a second, and is expressed in hertzes (one hertz (Hz)=one cycle per second). Wave length is expressed in terms of meters or portions thereof.

The electromagnetic spectrum is arranged according to increasing wave frequency and decreasing wave length, with short, high-frequency waves at the x-ray end of the spectrum and long, low-frequency waves at the radio-wave end of the spectrum. In other words, frequency is proportional to wave length.

Electromagnetic waves on the spectrum are collected into a number of groups and sub-groups. The two main groups are ionizing and non-ionizing radiation (see Fig. 1). Ionizing radiation is the uppermost portion of the electromagnetic spectrum and consists of hard and soft x-rays and gamma rays which are all high in frequency and short in wave length.

Ionizing radiation, which can cause cancer and birth defects as well as chromosomal damage, is the type of radiation most people think of when the term radiation is mentioned. VDTs give off less x-radiation than most television sets and most of that produced is absorbed or reflected by the glass screen.

To measure the actual quantity of x-radiation emitted, VDTs must be isolated in special laboratories in order to distinguish these emissions from natural background radiation. (A test of radiation being emitted from a VDT was conducted during the course of the hearings. The testimony explaining the test and results appears as Appendix D.) Even most advocates of VDT regulation acknowledge that ionizing radiation is not a problem in video display terminals.

Non-ionizing radiation refers to everything else on the electromagnetic spectrum: ultra violet, visible light, infrared, microwave, and radiowave frequencies. Biological effects of non-ionizing radiation in the lower frequencies merit more study to settle questions from a few medical researchers on hypothetical health effects.

Shaded in Figure 1 are types and frequencies of waves associated with VDTs, though not necessarily being emitted from the device. VDTs utilize low levels of nearly all types of waves except hard x-

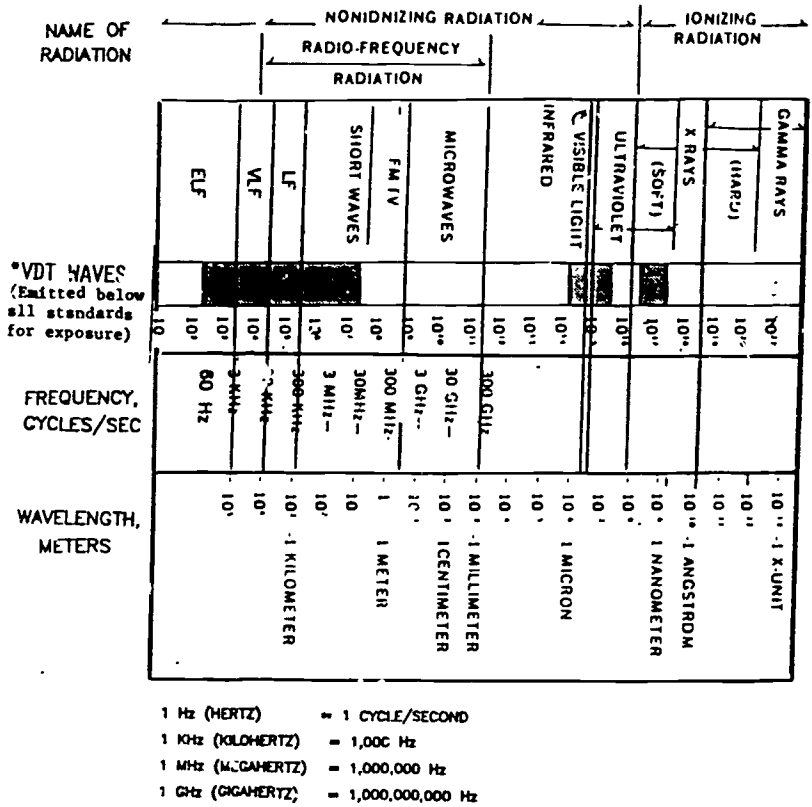
rays, gamma rays, and microwaves (with a few exceptions where very low level microwaves have been detected in some VDT models). As noted on the spectrum chart, emissions with known health effects are contained behind the glass phosphor shield of the VDT screen, and pose no hazard to the operator. The VDT radio frequency portion of the spectrum spans 3 sub-groups: low frequency, very low frequency, and extra low frequency waves. These are energy emissions common to many electronic appliances and may be found with hair dryers, electric baseboard heater, and small electric motors such as those found on electric typewriters.

There are four main sources of radiation in VDTs. The cathode ray tube (corresponding to the picture tube in a TV set) produces weak soft x-rays when the electrons in the electron beam, which moves across the screen to make the picture, hit the viewing screen. As emphasized before, however, the glass of the screen contains these weak x-rays, so they do not radiate outside the machine. If the glass VDT screen should break, the VDT would fail instantly like a broken lightbulb! As soon as it fails, it is no longer capable of emitting radiation.

The phosphorous coating on the back of the VDT screen gives off visible rays and may, depending on the type of phosphorus used, give off ultra-violet and infra-red light when it is bombarded with electrons from the cathode ray tube. Importantly, as with x-rays, these ultra-violet and infra-red rays are contained by the glass screen, and cannot reach the operator or others present.

FIGURE 1

THE ELECTROMAGNETIC SPECTRUM



*It is important to note that only part of the radiation *escapes* from the VDT mechanism The glass screen lets visible light escape, for example, while containing x-rays and ultraviolet light (VDTs emit less ultraviolet radiation than fluorescent lighting, for example)

Source U S Air Force, AFOSH Standard, 161-9, Oct 12, 1984; and Hearings, p 520

Computer circuits in some, but not many VDTs, have been found to generate extremely low level microwaves. The level of such waves is so small that they cannot be distinguished from background radiation in nature. It has been estimated that the amount of microwave radiation a VDT operator would receive would be about the same as if he were standing in an open field.

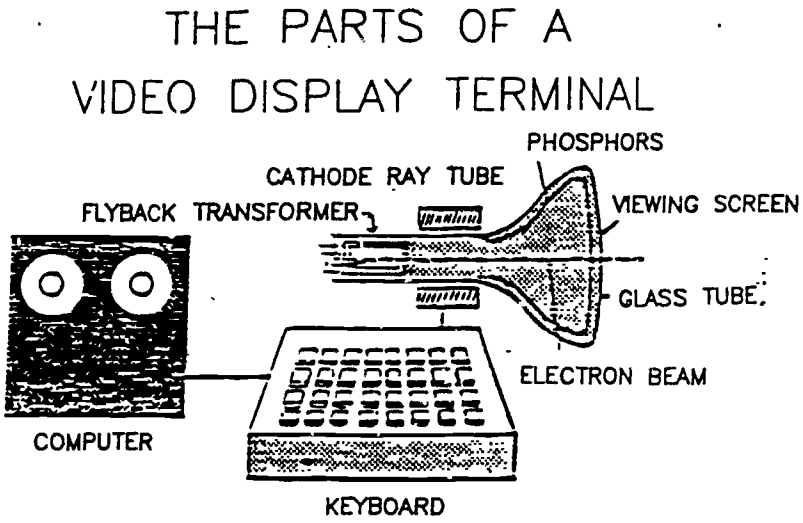
The horizontal deflection system, which moves the pulsating beam of electrons from the cathode ray tube back and forth across the screen, and its associated parts, the flyback transformer and related circuits, give off low-frequency radio waves, very low frequency waves, and extra-low frequency waves, as indicated previously.

The function of the flyback transformer and related parts is to generate enough high voltage to accelerate the electrons to high enough speeds to produce visible light when they hit the fluorescent screen.

How a VDT works

A video display terminal is similar to a television set, although the VDT gets its data from a computer or word processor instead of a broadcast signal. This information is then translated into an electron beam which is shot from an electron gun (cathode) inside a vacuum tube (cathode ray tube, or CRT) onto a coated glass screen (anode). (Breaking this vacuum tube would burn out the cathode and stop emissions.) As the electron beam moves back and forth horizontally across the screen, it goes on and off several thousand times per second so as to form the part of each letter that goes on a given "line". Bombarded by the incoming electrons, the phosphor coating on the inside of the glass screen in the CRT gives off a fluorescent glow which is the image seen on the outside of the screen. The type of phosphor used to coat the screen determines whether the glow produced will be white, green, yellow-green, or orange.

FIGURE 2



Source Hearings, p 52 Adapted from ... Hazards of VDTs, published by the Ontario Public Service Employees Union, Ontario, Canada, 1981

U.S. and foreign standards and measurements for lower frequency radiation

Two standards setting groups, the American National Standards Institute (ANSI) and the American Conference of Governmental Industrial Hygienists (ACGIH), have set new standards for lower frequency waves in recent years. These standards are advisory.

The standards were extrapolated from animal studies which suggest that the safe absorption level for humans was 4 watts of

energy per kilogram of body weight (4W/kg). To permit a large margin of safety, the standard was slashed to one-tenth of that level, or 0.4 W/kg. This was then converted to units of radiation from the power source [in milliwatts per square centimeter of surface area (mW/cm-sq)] which is measurable by common instruments.

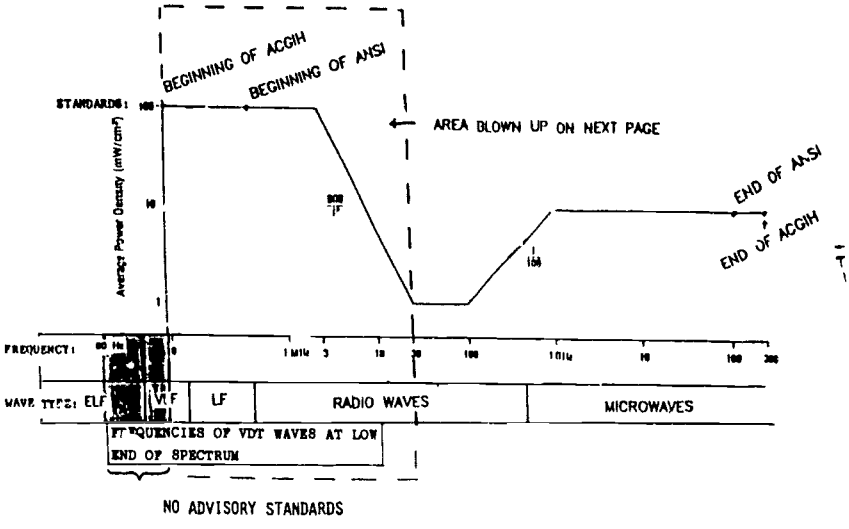
The resulting standards cover only part of the area of low frequency VDT emission. No standard covers the area from 10 KHz in the VLF portion of the spectrum, down to the ELF portion of the spectrum where the main current line feeds into the VDT at a frequency of 60 Hz, as is true for all electric appliances on AC current in the U.S.

Figure 3 shows the portion of the electromagnetic spectrum from microwave on down, depicting the ANSI and ACGIH standards. Note that no standard exists for a significant portion of the spectrum covering VDT emissions—the shaded portion below 10 KHz.

Figure 4 enlarges a part of Figure 3, superimposing upon the U.S. advisory standards mandatory standards for Czechoslovakia and the U.S.S.R., and measurements by three separate scientists. Note that although U.S. standards extend down to lower frequencies than do some foreign standards, standards for some other countries allow a lower maximum level of radiation than does the United States.

FIGURE 3

U.S. ADVISORY STANDARDS FOR LOWER FREQUENCY RADIATION

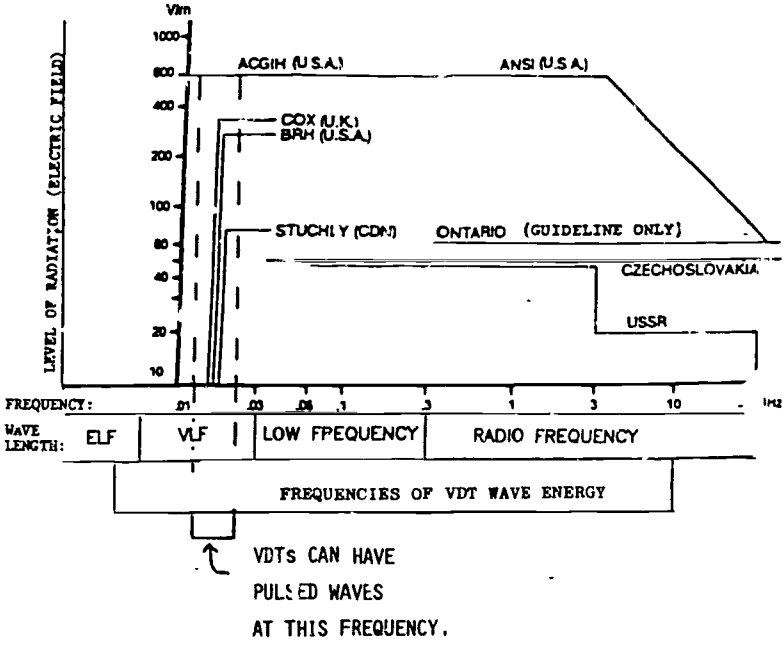


Source Adapted from TLVs, Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environmental and Biological Exposure Indices with Intended Changes for 1984-85, ACGIH

FIGURE 4

FREQUENCIES OF VDT ENERGY WAVES

U.S. VS. FOREIGN STANDARDS AND MEASUREMENTS



Source Adapted from Marha, Karel, et al The Case for Concern About Very Low Frequency Fields from Visual Display Terminals The Need for Further Research and Shielding of VDTs Hamilton, Ontario, 1983, Appendix 12

Summary of measurements of VDT radiation

The following table gives ballpark measurements of VDT emissions for all frequency ranges in which VDT emissions have been detected. J. Donald Millar, Director of the National Institute for Occupational Safety and Health (NIOSH), has testified that emissions of ultra violet, visible, and infra-red waves are less than $\frac{1}{100}$ of the allowable limits, and that emissions of radio frequency and x-rays are less than $\frac{1}{10}$ of allowable limits.

SUMMARY OF RADIATION STANDARDS AND MEASUREMENTS COVERING VDT WAVELENGTHS

Type of radiation	Standard[1]	Source of standard	Typical maximum radiation level
X-ray	500 mrem/yr 250 mrem/yr for pregnant women	ICRP NCRP	0.2 mrem/yr
Ultraviolet	1mW/cm sq	ACGIH	1/100 of standard
Infra-red	10mW/cm-sq	ACGIH	1/100 of standard

SUMMARY OF RADIATION STANDARDS AND MEASUREMENTS COVERING VDT WAVELENGTHS—Continued

Type of radiation	Standard [1]	Source of standard	Typical maximum radiation level
Microwave	1–10 mW/cm-sq	ACGIH/ANSI	1/10 of standard
Radio frequency	Varies from 1–100 mW/cm-sq depending on frequency	ACGIH/ANSI	1/10 of standard [2]
Very low frequency	10/ mW/cm-sq	ACGIH	1/10 of standard [2]
Extra low frequency	No standard	None	Not comparable

[1] For a visual graphing of the various standards along the electromagnetic spectrum, see figure 4
[2] still ¼ below standard near transformer

Note-
mrem = millirem, the unit of measure for ionizing radiation energy absorbed by living matter
mrem/yr = millirems per year
mW/cm-sq—milliwatts per square centimeter
ICRP = International Commission on Radiological Protection
NCRP = National Commission on Radiological Protection

A number of scientists, researchers, and interest groups have concluded that radiation energy from video display terminals is simply not a factor. For example, the Connecticut Academy of Science and Engineering has said:

In summary, numerous ailments and discomforts have been attributed by VDT users to these devices, and many of these attributions may be justified, but in no instance is there any reason to believe that radiation is among the causative factors

Other government testing has concluded the following:

Based on the radiation survey data from this investigation at the three sites and previous NIOSH investigations, it can be concluded that the VDT does not present a radiation hazard to the employees working at or near a terminal. (p. 68).

There is considerable technical difficulty in performing radiation surveys of VDTs since such surveys require considerable technical knowledge and skill in conducting the survey and interpreting the results. Considering this and low radiation levels emitted by VDTs examined to date, routine surveys at video display terminals are not warranted. (p 68).—*Potential Health Hazards of Video Display Terminals.* NIOSH Research Report, DHHS (NIOSH) Publication No. 81–129, June, 1981.

Extensive research has attempted to measure radiation levels emitted by VDTs. Reported results have been so low as to be negligible. Others have stated that there is more natural radiation in the environment in general than that emitted from VDTs. Health and Welfare Canada tested over 300 VDTs with their regulation instruments capable of measuring very low frequency radiation. It, too, concluded that there is no danger of radiation from VDTs. (p. 53).

The Federal Radiation Protection Bureau (Health and Welfare Canada) has stated, "There is no reason for any person, male or female, young or old, pregnant or not, to be concerned about radiation health effects from VDTs.", (Minister of Health and Welfare, Investigation of Radiation Emissions from Video Display Terminals, 83–EMD–91, 1983, p. 22).—"In the Chips: Opportunities People, Partnerships" Report of the Labor Canada Task Force on Micro-Electronics & Employment, 1982.

In no case did the levels found exceed the statistical fluctuations of background radiation. That is to say, the VDU's surveyed do not emit x-radiations. (p. 15).

At the operator position level, we measure values of 0.2–0.5 v/m, which correspond to the environmental background of electromagnetic and radiofrequency radiations. (p. 17).—Terrana, F., Merluzzi, F., Giudici, E. Institute of Occupational Health, University of Milan, "Electromagnetic radiation emitted by visual display units." In Grandjean, E. and Vigliani, E. Ergonomic Aspects of Visual Display Terminals, Taylor and Francis, 1980.

Overall, the results of the FDAs radiation testing generally agreed with those of earlier studies done by NIOSH and other organizations here and abroad. The consensus of the studies is that VDTs emit little or no harmful radiation under normal operating conditions; the emissions that are detectable are well below any existing national and international standards. Compared to some other common sources of radiation, VDTs present a much lower risk. Fluorescent lamps, for example, emit more visible and ultraviolet light. Space heaters give off more infrared radiation,

with no known ill effects And VDTs normally emit less x-radiation than TV sets (p 13)—William Rados, "VDT's Pass Medical Tests," FDA Consumer, April 1981

The American Academy of Obstetricians and Gynecologists has concluded that radiation emitted from VDTs is not significant enough to cause spontaneous abortions, birth defects, or any other adverse effect on the reproductive function.

The Academy's conclusion was based on a number of factors. First, considering the number of people using computer terminals, 50 such clusters will have occurred by chance alone in a 3-year period. Second, an estimated 10 to 30 percent of all pregnancies end naturally in miscarriages.

And, third, the types of birth defects suffered by babies of VDT operators have differed considerably from one another. The defects in the cluster at the Toronto Star, for example, where in one year 4 out of 7 women gave birth to babies with birth defects, included a club foot, an underdeveloped eye, a cleft palate, and a congenital heart defect. By contrast, birth defects related to the use of Thalidomide in the 1950's were of a very similar nature. Thus, the variety of defects and present medical conclusions on what causes such defects do not lend support to allegations that VDT operators face reproductive risks

The American Academy of Ophthalmology concluded, in reviewing VDT use as a cause of cataracts, that existing scientific evidence shows that VDT terminals are safe for normal use and present no harm to vision.

It is widely accepted, even by some critics of present VDT regulations, that VDTs do not emit significant quantities of ionizing radiation which is required for energy induced cataracts. The conclusion of the Academy is also based, in part, on analysis of several cases. First, six of the 10 cataracts reported were common, minor opacities which did not interfere with vision and four had occurred in people with known, pre-existing pathology of exposure to cataract-causing agents.

Second, 20 to 25 percent of the general population has small opacities in the lens which are visually insignificant, and, third, four percent of the population between 35 and 45 years of age suffer natural cataracts

VLF AND ELF RADIATION

VDTs have been found safe in spectrum areas of ionizing radiation and are considered safe by most researchers in frequencies of non-ionizing radiation. Yet, at least a few researchers urge additional study of low-frequency and extremely low frequency magnetic fields and energy outputs associated with VDTs and other appliances in this band of the spectrum. The radiation of particular concern to some researchers is pulse-modulated very low frequency (VLF) and extra low frequency (ELF) non-ionizing radiation.

Some have hypothesized that the ELF portion of the spectrum can have biological effects from specific frequencies of pulsed waves. Confusing the finding, however, is a discovery that these effects occur in "windows" of wave frequencies. That is, they only occur at very specific wave frequencies, and the effects cannot be reproduced with waves of frequencies either higher or lower than in the windows. Furthermore, even effects which occur at the same frequency as VDT emissions have not been proven for waves that

are identical in all respects to VDT waves. That is, they have not been proven for waves that have the same "wave form" (particular shape) as VDT waves. For the most part, actual VDT waves have not been thoroughly tested for various effects.

Finally, the magnetic fields associated with VDTs are of low power. Other common appliances such as electric mixers and baseboard heaters put out more ELF and LF energy than do VDTs. (See appendix B report on ELF/VLF fields.)

Reproductive hazards and video display terminals

The most serious charge is that VDT operation may in some way cause spontaneous abortions, birth defects, or otherwise impair reproductive health in women and men.

Against this suspicion is the testimony before the Subcommittee by physicians and other researchers on existing scientific findings is that there is no evidence of radiological emissions from VDTs which could cause spontaneous abortions or birth defects. Nor can other teratogens, mutagens or fetal toxins be identified by these scientists which could be linked to VDTs. One witness from the American Academy of Obstetricians and Gynecologists stated categorically that he would advise a pregnant female member of his own family that it was safe to work at a VDT station up until the day of delivery. A physician affiliated with the March of Dimes calls VDTs safe.

Even a remote possibility of harmful health effects from VDTs is serious enough to warrant thorough scientific study. In light of the seriousness of the concerns regarding birth defects and spontaneous abortions, NIOSH plans a major epidemiological study of health and safety problems which may or may not be associated with VDT operations.

In 1976 Marcus M. Bond, M.D., assisted the American College of Obstetricians and Gynecologists and the National Institute for Occupational Safety and Health in the development of the document "guidelines on Pregnancy and Work." Dr. Bond has also served on the American Medical Association's Advisory Panel on Reproductive Hazards in the Workplace, and has chaired that panel's subcommittee on effects of physical forces on reproductive functions.

Dr. Bond said experts in government and in private agencies agree that there is not enough radiated energy at the location of the worker using a video display terminal to do reproductive damage or cause any other adverse health effect.

A fundamental question regarding the possibility that video display terminal usage can somehow cause certain adverse pregnancy outcomes is whether there actually are statistical groups of such outcomes among VDT operators Or, is the population of pregnancy problems little different from that expected in our general population?

In statistical chance, even groups of adverse pregnancies (such as spontaneous abortion clusters) which may exceed that expected in the general population norm may occur in a large statistical population universe. Witnesses have testified that between 7 million and 10 million American workers use video display terminals in some way in their work. The Center for Disease Control (CDC) estimates that there are 7 million female VDT operators, many of

whom are of child bearing age. As has been noted, the CDC has estimated that spontaneous abortions in the general population occur at a rate of 15% of all recognized pregnancies, while the American College of Obstetrics and Gynecology estimates such spontaneous abortions occur at a rate between 10%-20% or higher, due to unrecognized instances of spontaneous abortion.

Given this data, the National Institute for Occupational Safety and Health, NIOSH, has estimated that if the seven million women working with, or near to, VDTs were divided into 100,000 groups of 70 women each, then over a two year period, there would be 613 groups with a two-fold excess of spontaneous abortion at $p=0.05$ level and 125 group at the $p=0.01$ level on chance alone. (This assumes a birth rate of 40.6 per 1,000 women)

Why do the adverse pregnancy outcomes of clusters differ?

Dr. Bond also asks a fundamental question about clusters which have been reported to the Center for Disease Control and to the Congress.

Why do the reported birth problems have no common specificity as would be expected from a particular cause such as the theory of adverse effects of an ELF magnetic field? In examining the outcomes of the *Toronto Star* cluster, it was noted that among the 14 babies born to employees in the Classified Ads section of the paper betwen May 1979 and May 1980, seven had mothers who were VDT operators for at least part of this time. Of these 7 births, four had defects. These defects were an underdeveloped eye, club foot, cleft palate, and a hole in the heart.

A family history of cleft palates was noted in the case of that birth defect and club foot defects are considered to result from insufficient space in the womb.

The NIOSH office of the Centers for Disease Control has also noted the following birth problems among the reported clusters of adverse reproductive outcomes:

Down's Syndrome, spina bifida, bronchitis, miscarriages, premature birth, respiratory disease, stillbirth, and some severe birth defects. The problems in citing these adverse outcomes as evidence to suspect VDTs of pathological effects is that some of these outcomes are regarded by medical scientists to be traced to genetic histories, and are not in all cases outcomes which could be expected from exposure to radiation. Fortunately, ionizing radiation in VDTs is so low that it cannot be measured without isolating VDTs from the background radiation of any office environment.

Dr. Bond noted that VDTs emit less x-ray radiation than television and other witnesses could not cite any examples of reproductive complaints stemming from exposure to television tubes.

In 1981, the Bureau of Radiological Health conducted worst case tests of 125 VDTs in an effort to produce measurable radiation. Of these, 8 could be made to produce x-ray measures above the 0.5 Mr/hr. level. The U.S. standard is 2.5 Mr/hr. Of these eight, there were three brands of VDTs. One unit brand burned out, ending the production of emissions. Another was recalled and the third was never marketed.

Microwave emissions were tested by the American National Standards Institute and found to be 100 times below the allowable standard.

Bell Laboratories tested 33 VDTs in 1979. They found emissions on various wave lengths between 1/10th and 1/100th of the allowable standard.

The Federal Radiation Protection Bureau of the Health and Welfare Ministry of Canada has stated, "There is no reason for any person, male or female, young or old, pregnant or not, to be concerned about radiation effects from VDTs." (Minister of Health and Welfare VDT Investigation, 1983.)

Indeed, the concensus appears to be that VDTs do not produce dangerous levels of radiation energy.

In the article "VDTs Pass Medical Tests," FDA Consumer, April. 1981, Mr. William Rados wrote:

> Overall, the results of the FDA's radiation testing generally agreed with those of earlier studies done by NIOSH and other organizations here and abroad. The consensus of the studies is that VDTs emit little or no harmful radiation under normal operating conditions; the emissions that are detectable are well below any existing national and international standards. Compared to some other common sources of radiation, VDTs present a much lower risk. Fluorescent lamps, for example, emit more visible and ultraviolet light. Space heaters give off more infrared radiation, with no known ill effects. VDTs normally emit less x-radiation than TV sets.

Some critics have pointed to the extremely low frequency emissions and magnetic fields of VDTs as a possible cause of adverse pregnancy outcomes. However, these fields of energy are comparable to or in some cases less than similar fields from electric baseboard heat, irons, hair dryers and other items which are not only found around households, but are workplace tools and fixtures as well.

Officials of NIOSH have said that if VDTs are somehow adversely affecting reproduction, then they do not know how they are doing so.

In another instance, witnesses on behalf of the Communications Workers of America postulate that PCBs emissions in the form of chemical vapor may represent a hazard. However, it is older models of VDTs which have transformers cooled by PCBs. Even these were typically sealed. Few workplace VDTs are cooled by PCBs today, certainly not enough to expose a number of workers and yield a variety of adverse pregnancy outcomes.

Two organizations, the Newspaper Guild and 9 to 5, sponsored surveys of worker health complaints associated with VDTs, including a focus on reproductive concerns.

NEWSPAPER GUILD-MOUNT SINAI SURVEY

In conjunction with the Newspaper Guild and the Mount Sinai School of Medicine, Dr. Arthur L. Frank, Chairman of the Department of Preventative Medicine and Environmental Health at the University of Kentucky, mailed a multi-page questionnaire to newspaper and wire service workers in six locations: Memphis, St. Louis, Toronto, Vancouver, Honolulu and New York City.

Questionnaires were sent to both VDT and non-VDT users, but the exact numbers of VDT users responding to the questionnaire is

unclear. Dr. Frank estimates that 60 per cent of the 1,047 questionnaires that contained useful information were from VDT users.

Of the total female population of this study, seven per cent reported miscarriages. (The miscarriage rate for the general population is estimated to be between 10 and 20 per cent by the American College of Obstetricians and Gynecologists.)

The study reported 62 miscarriages from 57 individuals. Women surveyed reported 39 miscarriages and men responding reported 18 miscarriages by their wives. Of the reported miscarriages, 15 had occurred since 1977. Seven persons who reported miscarriages were VDT users and three were not. The remainder of the respondents reporting miscarriages could not be categorized as VDT or non-VDT users.

Dr. Frank notes that the data collected is difficult to compare with other studies since the total population includes women of various marital status and age.

9 TO 5 SURVEY

The 9 to 5 survey emerged from the establishment of a May, 1983 Campaign on VDT Risks by the organization. A telephone hotline was set up to solicit calls on VDT user complaints and more than 6,000 persons responded.

The group of 6,000 telephone respondents made up the study sample. Of the 6,000 questionnaires distributed to those telephone respondents, 873 (just under 15 per cent) were completed and returned.

While 9 to 5 acknowledged that the study was for educational and outreach purposes and did not reflect random samplings of office workers, the group nevertheless concluded that reproductive problems were high among the concerns of VDT users who responded. Of those who had been pregnant since working with VDTs, 30.6 per cent said they had suffered miscarriages.

The rate of birth defects reported in the survey was also high (6.8 per cent as compared with a national norm of 2 to 3 per cent).

A large number of respondents expressed concern about the potential effects of VDT usage on their current or future pregnancies. In addition, while interest was expressed about the possible effects on paternal reproduction, not enough males were included in the study sample so as to focus on the issue.

In forming its conclusions, 9 to 5 expressed concern about the rate of normal, full-term deliveries (31.6 per cent) among those VDT operators participating in the survey who had become pregnant while working with VDTs. Yet, because of the self-selected nature of the survey respondents, 9 to 5 agreed it would not be possible to say that the same percentage would apply to all users of video display terminals.

The Newspaper Guild, 9 to 5 and others also cited reported clusters of pregnancy related problems such as stillbirths and birth defects among particular groups of women working with VDTs or in a VDT office environment. Charles Perlick, Newspaper Guild president, cited the cluster of birth defects at the Toronto Star and Jackie Ruff of 9 to 5 noted that at least 15 VDT work environments where multiple miscarriages, birth defects and other preg-

nancy problems had occurred had been reported to her organization.

She cited a specific cluster at a United Airlines office in San Francisco where approximately 300 workers had full-time VDT duties. Over a four-year period at that office, there were 48 pregnancies. Of those, 24 were said to have ended in miscarriage, birth defects, stillbirth or neo-natal death, premature birth or other problems.

STUDIES BY CANADIAN SCIENTISTS

In 1982, Dr. Karel Mahra, associated with the Canadian Centre for Occupational Health and Safety, presented an abstract of a study he conducted which concentrated on extremely low frequency and electromagnetic fields of energy associated with video display terminals.

Marha's study postulated that low frequency radiation and, in particular, pulsed electrostatic fields can influence biological functions. In his conclusion, Mahra noted that "VDTs may produce electric, magnetic and electromagnetic fields in nearly the entire NIR band. The highest intensity fields can be found in the low-frequency spectrum. Most of these are pulsed fields of extremely low-frequency modulated fields. . . . All of these fields are known to produce some biological effects. The complex evaluation of all possible factors, including a combination of different fields and all other hygenic and ergonomic factors near VDTs has not been done."

In another paper, "The Case for Concern about Very Low Frequency Fields from Visual Display Terminals: The Need for Further Research and Shielding of VDTs," for the Canadian Centre, Mahra and colleagues, Barry Spinner and Jim Purdham concluded that most bands of energy emissions are not dangerous given their low levels or shielding in VDT devices. Very low frequency waves, however, have not been examined sufficiently to completely rule out adverse effects.

Reported clusters of birth defects and spontaneous abortions

Office	*City*
Air Canada-Dorval Airport	Montreal, Pq [1]
American Express	Great Neck, NY [1]
Boston University	Boston, MA
Defense Logistics Agency	Marietta, GA
Pacific Northwest Bell	Tacoma, WA [1]
Sears and Roebuck, Co	Dallas, TX [1]
Solicitor General's Office	Ottawa, ON [1]
Surrey Memorial Hospital	Vancouver, BC [1]
Terra Nova Tel	Gander, NF [1]
Toronto City Hall	Toronto, ON
Toronto Star Newsoaper	Toronto, ON
United Airlines	San Francisco, CA

[1] Noted in paper by David A Butler, Video Display Terminal Use and Spontaneous Abortion Exploring a Possible Link, (SUPA) Carnegie Mellon University, Pittsburgh, PA, 1985, Table p 29

This is not intended to be a comprehensive list Other clusters may be reported In addition, this list does not mean to imply that all of these clusters have been investigated in a scientific manner

Other Clusters noted by witnesses before the Subcommittee

In their paper, the researchers said:

It has become apparent that the radiation conventionally considered most suspect, x-rays produced in the cathode ray tube, should not represent a significant source of risk, since published measurements show that the degree of exposure associated with operation of visual display terminals is negligible. Similar findings were obtained for portions of the non-ionizing radiation spectrum, particularly ultraviolet, visible, infrared, and microwaves. The attempts to measure x-rays and other emissions from VDTs, the biological effects and subsequent risk assessments have been studied and published elsewhere.

However, one portion of the electro-magnetic spectrum, that is known as the very low frequency spectrum occurring between 3 and 30 kilohertz, has not had the same attention. Consequently, this area was examined closely. It was found that while the evidence could not in any way be considered to constitute proof of harm, it did show that there was cause for concern.

The researchers asserted that certain components of typical VDTs, namely the "flyback" transformers, produce directional magnetic and electronic fields. According to the three scientists, these fields need not be strongest in front of a VDT screen. They expressed disappointment that most measurements of these fields have been in front of the screen rather than comprehensive assessments of all surfaces.

We should emphasize that there is no direct evidence of biological effects of fields from VDTs, Mahra Spinner and Purdham said Also, to our knowledge, there is no published work which shows the absence of any effects.

The paper, additionally, briefly outlined an embryotropic effect study of electrostatic fields on mice.

PROPOSED NIOSH STUDY

Dr. J. Donald Millar, Director of NIOSH, noted during testimony that previous investigations by the agency suggested that the introduction and growth of VDTs in the workplace had produced few problems considering the scope of the technological change.

He reported that in 1977, NIOSH had tested video display terminals for health dangers from ionizing and non-ionizing radiation and found that emissions from VDTs fell far below the existing national occupational guidelines. Ultraviolet radiation was less than 1/100th of the allowable standard, whle RF and x-ray levels were less than 1/10th of allowable limits. Extremely Low Frequency (ELF) emissions are not covered by national occupational standards except for the military, but even the measured ELF levels were less than those emitted by hair dryers, other household appliances and electric baseboard heating units.

Due to the seriousness of concerns by various groups and the expanding usage of VDTs, NIOSH has decided to conduct another survey, including a major epidemiological study of reproductive complaints among VDT users.

Draft protocols of the NIOSH study

The principal focus of the study would center on three points:

Do women who work with VDTs experience an increased risk of adverse pregnancy outcomes compared to women who do not work with VDTs?

Do other risk factors, including personal usage of alcohol, tobacco and drugs, maternal health histories and ergonomic stress, add to reproductive problems?

The study is aimed at reproductive conclusions and does not test questions of vision, musculoskeletal problems, or levels of radiation.

The study, which was expected to begin in the Spring or Summer of 1985, would include comprehensive interviews with 4,000 married females between the ages of 18 and 44 (2,000 VDT users and a control group of 2,000 non-users) with regard to their health, reproductive history, occupational history and other factors, such as usage of alcohol, tobacco and drugs, which might influence health outcomes.

Additionally, researchers at New York's Mount Sinai Hospital Medical School are planning a large-scale study that will survey 10,000 VDT workers over a four-year period to determine whether VDTs pose a health risk to pregnant women.

Vision and Video Display Terminals

Another concern raised concerning radiation effects of VDTs focused on vision problems and, more specifically, cataracts. Newspaper Guild representatives expressed their belief that VDT usage could cause cataracts and cited two cases of employees, aged 29 and 35, at The New York Times, who had been diagnosed as having cataracts caused by radiant energy. In total, eight cataract cases among Newspaper Guild members were reported over a five-year period.

When two employees at the Baltimore Sunpapers reported cataracts, NIOSH was asked to conduct an ophthalmological study.

The NIOSH study found no greater incidence of cataracts among VDT users than among non-users, indicating, however, that the VDT operators had not been working with the equipment long enough for the study to be conclusive. The study did conclude that the bothersome visual aspects of the terminal itself explained the plurality of work-associated symptoms—headaches, burning eyes and blurred visions—reported by many of the VDT users surveyed by NIOSH.

The study by Dr. Frank, sponsored by the Newspaper Guild, took note of the National Research Council report that there had been "no well designed studies suggesting an association of VDT work with cataracts or other ocular abnormalities."

Nevertheless, the Newspaper Guild called for strict regulation of lighting, annual eye examinations, and employer provision of corrective lenses for VDT operators.

The witnesses from 9 to 5 also included concerns about vision, comfort and cataracts in the points they made to the Subcommittee. The representatives from this union called for annual vision examinations to be provided by employers for all VDT operators.

Mrs. Rebecca Alford, speaking on behalf of 9 to 5, said:

> Many of us have noticed the deterioration of our vision since working on the terminal. Some have had to wear corrective lenses for the first time. Others have had their prescriptions strengthened. One employee was told by her ophthalmologist that he is sure her recent eye problems were caused by prolonged exposure to the cathode ray tube, but that he had no way of proving it. At home, after a day on the tube, I have a difficult time focusing on close objects. My eyes frequently tear and sting. Only after a weekend away from the terminal do my eyes begin to feel better.

The witnesses for the Communications Workers of America also expressed concerns about the possible deterioration of vision from VDT work. Mr. David LeGrande of the CWA said, commenting on a study of telephone operators using VDTs:

These and additional studies have indicated different types of visual discomfort may produce various effects. For example, severe optical discomfort such as eye irritation, soreness, and tiredness may not go away within a short period of time following work and may even be present at the start of the next day's shift Health effects related to visual performance like blurred vision may have a recovery period of 15 to 20 minutes or more. These visual problems may be most pronounced among VDT operators 40 years of age and above.

Witnesses for the American Electronics Association, Charles N. Abernethy, Ph.D., and Manager of Human Factors for Digital Corporation, and Max M. Weiss, Ph.D., from the Radiation Protection Group at Bell Laboratories of AT&T, noted that the National Research Council detailed its Committee on Vision to take part in their study of VDTs. That committee said:

We find no scientifically valid evidence that occupational use of VDTs is associated with increased risk of ocular disease or abnormalities, including cataracts.

Dr. Abernethy and Dr. Weiss pointed out that 25% of the population have general opacities of the lens which do not affect vision. These witnesses also said that 4% of the population between 35 and 45 suffer from naturally occurring cataracts.

They also stressed that there were no causal agents associated with VDTs to give operators cataracts. They cited the Connecticut Academy of Sciences study which noted that the radiation needed to induce a cataracts would exceed 10,000 times that possible from a VDT.

These witnesses cited a report from the National Academy of Sciences which noted:

We find no scientifically valid evidence that the use of VDTs per se causes harm, in the sense of anatomical or physiological damage to the vision system . . .

Ten anecdotal reported cases of cataracts among VDT workers do not suggest an unusual pattern attributable to VDT work: six of the cases appear to be common minor opacities not interfering with vision, and each of the remaining 4 cases had known, pre-existing pathology as exposure to cataractogenic agents.

These witnesses further noted that NIOSH, the University of Laval Hospital, Quebec, and the British Post Office studies concluded that VDTs have no harmful effects on vision.

Physicians from the American Academy of Ophthalmology—Dr. William L. Rich, III, Dr. Martin A. Mainster, and Dr. Alfred Sommer—said that while heavy visual work which may occur in VDT use can cause eye discomfort, it cannot cause permanent damage to the eye.

There is no clinical or experimental evidence that ocular fatigue experienced by some VDT users can cause any pathologic change."

The Academy does not at this time believe that available scientific evidence warrants annual ophthalmologic or optometric eye examinations purely on the basis that a worker regularly uses a VDT

Their policy statement said that ocular examinations should be based upon the presence and probability of visual system abnormalities. Individuals with adverse symptoms need prompt examinations. Low risk patients should simply follow a schedule of examinations designed to detect ocular disease efficiently.

In addition to serving as a practicing ophthalmologist in Falls Church, Virginia, Dr. Rich has served on the American Academy of Ophthalmology's representative on the National Research Council study of VDTs. Dr. Rich is also on the Legislative and Public and Professional Information Committee of the AAO. Dr. Mainster holds a Ph.D. in physics and an M.D. He is Director of the Clinical Research Center at the Eye Center of the Retinal Foundation in Boston. Dr. Sommer holds a master's degree in epidemiology in addition to his medical degree. He is director of the Dana Institute for Preventive Ophthalmology at Johns Hopkins University.

Dr. Mainster said that even those who have had lenses removed in cataract surgery are not at risk in using VDTs. The level of ultraviolet light from VDTs is too low to pose a risk even to these individuals.

The witnesses stressed that VDTs could not harm eyesight. Even the question of comfort for eyesight in operators is improving. The doctors noted that improvements in the quality of equipment are offering more adjustability and brightness control to individual users of VDTs.

NIOSH had some different recommendations regarding vision and VDTs than did the ophthalmologists.

While both organizations called for flexibility in illumination and adjustment equipment, NIOSH adds that VDT operators should receive visual testing before beginning VDT work and should receive such tests periodically thereafter to insure corrected vision.

Dr. Howard Brown, Medical Director for The New York Times dismissed allegations about a reported cluster of cataracts among employees at the newspaper pointing out that one of four workers cited in the cluster did not have cataracts, another had never worked on VDTs and NIOSH failed to find any causal relationship for the other two.

Dr. Brown pointed out that in October 1983, 25,000 physicians of the Medical Society of N.Y. passed a resolution opposing VDT legislation pending in the New York Legislature.

The Newspaper Publishers Association also conducted radiation testing for the Subcommittee. Mr. Neergaard showed the reading for ultraviolet radiation off the screen face of the video display terminal and found infrared radiation to be less than that of the background radiation in the room. Other levels of ionizing radiation were indistinguishable from background radiation.

Ergonomic Issues

Ergonomic is defined in Webster's New Collegiate Dictionary, 1979, as: of or relating to biotechnology.

Others have used the term ergonomics to describe the interrelationship between man and machine.

When the term ergonomics is applied to computer terminals, it is an assessment of the comfort and ease of operations of the physical plant, consisting of the VDT unit, lighting, furniture, and other physical apparatus necessary to get the job done.

Interestingly, all witnesses, including representatives of computer manufacturers and business furniture designers and marketers,

agreed that there can be poor computer work settings which cause discomfort to computer users in a variety of ways.

Witnesses did not agree on the extent of the problem, or whether government legislative regulation is needed to standardize computer components, computer furniture design, lighting, and other equipment used with VDTs.

Musculoskeletal problems, office temperature, lighting and vision comfort, were all cited by spokesmen for the three labor organizations seeking Congressional action to regulate computer terminal operations in the workplace.

Witnesses from 9 to 5 noted the portion of their May 1983, informal survey which logged various complaints regarding comfort in the workplace. The average respondent is female, works 6 to 8 hours daily on a plastic-cased VDT, her eyes 10 to 20 inches from the VDT screen without rest breaks other than those given to all other workers.

The majority of respondents "often or daily" experience eyestrain (53.5%), exhaustion (51.6%) and/or muscle pain (56.2%). Of all respondents, 48% report diagnosis or treatment by a physician since working with VDTs for vision problems or changes in eyesight; 19.2% report treatment for gastritis or nervous stomach; and 14.9% report diagnosis or treatment for high blood pressure.

Complaints of monitoring of keystrokes are also linked in part to comfort complaints by 9 to 5. One witness said:

> Back and neck problems are a result of chairs, tables and desks that we cannot adequately adjust and of long hours sitting in one position Getting up and moving around during the day to alleviate cramping and stiffiness and give our sore eyes a rest is discouraged, and in fact, is penalized, since our machines are electronically monitored for productivity.

Mr. LeGrande shared a survey on comfort issues among directory assistance operators conducted jointly by NIOSH and the University of Wisconsin. It consists of 50 operators using VDT screens, and 50 operators using other equipment. While it is difficult to draw significant conclusions from such a small sample size, this survey is reprinted in this report to illustrate some of the issues regarding comfort in the use of VDT equipment.

Mr. David LeGrande of the Communications Workers of America registered his concerns about ergonomic factors and video display terminals in America offices.

> . . . in large part a discussion on VDT design might also be thought of as a discussion on ergonomics. Ergonomics, or human factors, as it is commonly referred to in the United States is the study of the relationship between human beings and the work process and environment. Simply put, ergonomics means fitting the work place to meet the needs and characteristics of workers rather than having employees adapt to meet the design of workplace tools and equipment. A discussion of the ergonomics of VDT work places should include consideration of VDT design, work station design, work place design and work organization design

The CWA witness suggested the following:

> Variables important to VDT workstation design include the VDT table, chair, document holder, lighting, footrests, and arm and wrist rests to allow for operator adjustment.
>
> In addition, all too often VDT equipment is installed in traditional offices with little or no redesign of the workplace. In many cases, workers have witnessed the implementation of VDTs into their work environment without proper consider-

ation of ergonomic factors. Variables important to proper VDT workplace or work environment design include illumination, temperature, humidity, and noise.

The proper amount of workplace illumination is essential for VDT work to be performed without visual discomfort and fatigue. Improper illumination is characterized by scientists as a major cause of operator visual, musculoskeletal, and job stress related health symptoms. In general researchers suggest that VDT workplace illumination levels should be much lower than in traditional offices.

VDT workplaces should be engineered and maintained to provide comfortable temperature and humidity levels. Proper spatial design of the workplace, maintenance of temperature and humidity controls, and prevention of wide variations in temperature and humidity controls, and prevention of wide variations in temperature will help reduce illnesses and lost-work time and help increase worker morale, efficiency, and productivity.

At the invitation of Representative Steve Gunderson of Wisconsin, Mr. LeGrande conducted a brief assessment of the computer work stations in Congressman Gunderson's office.

Among his findings, Mr. LeGrande noted glare from office windows obscuring readings on computer video display screens. He also pointed out that the equipment had adjustable keyboards, free from the main computer terminal cabinet, yet these keyboards were rendered less adjustable due to confined space on office desks designed for use with typewriters rather than computers. Flexibility in positioning equipment was a key recommendation of Mr. LeGrande.

Like the Newspaper Guild, SEIU, and 9 to 5 organizations, the CWA called for Congressional action to regulate equipment, workplaces, and workpractices associated with video display terminals.

Among some of the work comfort recommendations by witnesses for 9 to 5 were:

Quality and safety features should be standard for all equipment. (See "The Human Factor", 9 to 5's Consumer Guide to Word Processors.)

Provide training and information to purchasers of work processing equipment.

Order only VDT equipment with adjustable screens, keyboards and glare-reduction devices; provide work environments, furniture, and lighting designed for the comfort and safety of the operator. Provide regular eye examinations for all VDT workers.

Eliminate stress-inducing features of automated jobs such as machine-pacing or computer-monitoring.

Establish minimum rest breaks of 15 minutes for every two hours of VDT work; 15 minutes every hour of intense VDT work. Limit continuous use of VDTs to four hours each day.

Provide training and information about proper placement, lighting, work area redesign, maximum daily use, rest breaks, maintenance and monitoring of equipment.

Mr. Stephen D. Channer of the Business and Institutional Furniture Manufacturers Association did not dispute that some work environments are uncomfortable for office workers using VDTs.

Mr. Channer defined the problem this way:

> One of the real problems in the market place is not that the right furniture is not out there, it is that management and people who employ workers have not given enough time, to this point, to the education of how to use that type of furniture. They have also, in my opinion, not given enough attention to ensuring that each of the workers is provided with the correct furniture.
>
> So if there is a greater emphasis—I think that it is probably one of the greatest things that will come out of these kinds of hearings—if there is a greater emphasis for management and for employers to ensure that the workers receive the right product to use, and then there is an educational program to see that that worker knows how to use that furniture, how to adjust it to their needs, I think that will serve, to a great extent, to solve some of the concerns about comfort and posture and neckache and backache, and so on.
>
> I, myself, have gone into offices where I have seen word processors put on desks that were too high. I have seen people using them in chairs that were not the proper chair.

NIOSH recommendations for comfort

Maximum flexibility in workstation. Hardware is the key element to good design for ease of VDT operation according to NIOSH in 1980 recommendations.

Chairs should have adjustable height, backrest, and tension.

Keyboards and screens, should have independent adjustability.

Consideration of distance to the eyes should give some individual flexibility.

NIOSH recommends lighting levels of 500-700 lux, depending on the other uses of work area. (For example, typewriter use requires brighter light than VDT screens which may be easier to read in room lighted for contrast.

Glare can be controlled with drapes, shades, blinds and hoods for VDT screens.

Direct lighting, so important in traditional offices of the past, may be too bright for VDT screens. Thus indirect lighting is recommended to cut glare.

NIOSH recommends a 15 minute break every two hours to relieve eye and muscular fatigue—every hour for particularly rigorous VDT use.

In September 1983, BIFMA (Business and Institutional Manufacturers Association) sponsored an inter-disciplinary symposium on the human factor in office design. Experts on ergonomics, lighting, acoustics, and automation participated. The BIFMA goal for this symposium is to establish specific recommendations on design for comfort and safety in manufacturing VDT related office furniture.

The BIFMA representative cautioned that egonomics relies on adjustability since human beings differ in size and requirements. Thus, guidelines should emphasize flexibility, and ought not offer precise engineering prescriptions.

BIFMA recommended that there be an analysis of the tasks to be performed before furniture is purschased for workers. and that workers receive training in understanding adjustment controls on chairs and other office furniture and equipment.

The witness noted that the General Services Administration uses BIFMA safety and performance standards as criteria for furniture for the Federal Government.

BIFMA is presently working with the American National Standards Institute (ANSI), CBEMA, and the Human Factor Society to develop guidelines for use of furniture in conjunction with electronic equipment.

BIFMA opposes the model bill offered by the Newspaper Guild in light of the sepcificity for parts of a chain and other terminal associated-furniture in the proposed legislation. BIFMA counters that this specificity negates flexibility of choice which accommodates more of the population.

Dr. Abernethy, who spoke on behalf of the American Electronic Associaton and also serves as manager of Human Factor Design Group at Digital Corporation, called ergonomics, "the legitimate area of major concern." He divided ergonomic complaints into two categories:

> (1) Visual, where improper brightness on improper veiwing distance from the screen can result in eye strain and headaches, and, (2) postural. Designers make furniture adjustable so that, except for the smallest of females and the largest of males, it will be comfortable for 90% or more of the population.

Dr. Abernethy noted that even the tasks of VDT operators can improve significantly. A NIOSH study found that data entry operators look at the screen 14% of the time, while interactive operators look at the screen 34% of the time as they make inquires and real responses.

Abernethy also noted a study funded by NIOSH *which* showed a 25.4% increase in productivity and a decrease in musculoskeletal complaints. This provides a powerful incentive for office outfitters to seek out proper furniture for VDT tasks. (Dainoff, M., "Visual, Musculoskeletal, and Performance Differences Between Good and Poor Workstations: Preliminary funding—*Proceedings of HF Society 26th Annual*, Seattle, Washington, Oct. 1982.)

This group said that some companies provide adjustable terminals and offer guide books and handbooks for proper setting and use of their equipment.

Dr. Abernethy concluded:

> Concerns about eye discomfort, glare and muscular aches for VDT operators can be effectively addressed by appropriate work station design. Research has shown that these problems are experienced by non-VDT users as well The work station should be designed with flexibility in order to accommodate a wide variety of people and work positions.
>
> It is AEA's perception that the proper approach to the issue of providing workers who use VDTs a safe and comfortable work station can best be accomplished by accommodating the individual needs of the VDT user as developed by management and workers or their representatives and not by mandatory governmental regulations and standards.

William L. Rich, M.D., American Academy of Ophthalmology, said that nothing in the nature of VDT work suggests to the Academy that annual eye examinations are appropriate or needed for all VDT users.

There is no evidence that any pathological condition or refractive error will be made worse by the use of a VDT. The demanding

visual task of a VDT may bring to the attention of a worker an uncorrected ophthalmolic condition or refractive error that otherwise was not apparent to them.

Dr. Rich noted an eye comfort problem which can be inadvertantly over looked. Persons needing reading corrective lenses are often fitted with reading bifocals. even though VDTs require the need to look upward at the screen instead of down at text copy. Such persons may need separate reading glasses for VDT use.

George Cashau of the American Newspaper Publishers Association noted that glare, illumination, furniture design room, design, contrast controls all figure in ergonomically sound VDT work stations.

However, Cashau noted the great variety of regulations which exist abroad:

One German standard suggests positive images on the VDT screen. In contrast, a English trade union standard advocates negative images. Under one German DIN standard, the preferred color of the display images is green through orange. The Technical University of Berlin suggests yellow-green. The Canadian Defense and Civil Institute of Environmental Medicine standard provides that images should be allowed on green or white.

Illumination varies from low to very bright from country to country. The recommended lux range for VDTs goes all the way from 200 to 1076. For example, the Technical University of Berlin recommends 500 lux while the Canadian standard is 807-1076 lux. The glare control standard also varies. The very specific APEX English trade union standard requires a glare index of 16 or less as compared to the German standard which calls for diffusing surface, micromesh filters, thin firm optical coatings, sprays, hoods and combination filters.

ANPA provided the committee with a multi-page table compiling various recommended standards for VDT functions. (See appendix C).

Dr. Howard R. Brown, Medical Director for the *New York Times*, speaking on behalf of the ANPA, chairs the environmental committee of ANPA and is a specialist in occupational medicine.

He noted that more than 50,000 VDTs are in use in newspapers throughout the country. Most are in newsrooms, but VDTs are also found in advertising departments, mailrooms, business offices and elsewhere in newspaper offices. He pointed out that the newspaper industry was subject to several NIOSH studies.

Dr. Brown questioned the findings of Dr. Arther Frank, M.D. The Dr. Frank study also known as the Newspaper Guild—Mount Sinai study found higher levels of eye strain and musculoskeletal problems among VDT users.

Dr. Brown termed this report a "purported" scientific study and questioned the proprietory of conclusions drawn from a study lacking "peer review" and based upon anecdotal evidence.

Dr. Brown called attention to an October 1983 resolution by the 25,000 member Medical Society of New York which opposed VDT legislation pending before the state legislation.

Representatives from the American Newspaper Publishers Association offered several letters from member newspapers detailing

their actions to provide efficient and usable workplaces. One of these letters is reproduced here.

CALL-CHRONICLE NEWSPAPERS, INC.,
May 25, 1984

Mr. RICHARD W NEERGAARD,
Assistant Environmental Coordinator, American Newspaper Publishers Association, The Newspaper Center, Reston, VA

DEAR RICHARD: Over the last three years, the Call-Chronicle has purchased and installed a Sil System/55 Advertising and News Processing system At the same time, we were expanding our facilities by building a new Editorial room, Library, Art Department and a number of meeting rooms.

When planning the new Editorial room we know that everyone working the area would be using terminals.

"Ergonomics" became the key when we designed the room.

Some important items were:

(1) Glare and reflections from windows had to be controlled. The newsroom was designed with no windows. Offices and meeting rooms, along with the Art Department and Library, were placed on the outside walls. These prevent outside light from reflecting on the VDT screens.

(2) Lighting also creates reflections on the screens. To get around this problem, all lighting in the Editorial room is of the indirect type Basically they are fixtures hung about four feet from the ceiling with the light being directed upward, causing the light to bounce off the ceiling.

(3) Special work stations were installed which contain a lowered area for the VDTs, bringing the keyboard to a comfortable height for the operators.

(4) New chairs were purchased. They allow easy adjustment of the backs and seats.

(5) The Editorial room walls are covered with a material which will not reflect lights.

(6) The complete room has a raised floor which allows all wiring to be routed under it.

(7) Offices on the outside walls have windows which start at about seven feet from the floor. This reduces the chances of reflection on the VDT screens used in the offices. The lights have parabolic lenses under them to reduce reflections.

The Call-Chronicle Bureau in Bethlehem contains 11 VDTs in a room with large windows We are completing renovations to this area which will give VDT operators a more ergonomically sound place to operate terminals

The changes are:

(1) The room was repainted using a flat paint—it had been a glossy finish.

(2) Parabolic lenses were installed on the lights

(3) New work stations were purchased to insure the correct height for the keyboard.

(4) New easily adjusted chairs were added.

(5) Drapes will be installed on the windows to cut down daytime glare

These changes constitute a major expenditure for the Call-Chronicle Newspapers but it gives the employees an area where they can comfortably work.

Sincerely,

GLENN A SHANK, *Vice President*

Mr. Frank Romano, publisher of *Type World* and chairman of the board of the National Composition Association, a section of the Printing Industries of America, and his associates stressed the usefulness of video display terminals to their work as well as ongoing innovation which aids their print industry.

As an example of innovation, Romano noted that cathode ray tubes for video display terminals are not always used for data display.

We feel that the nature of the work and the workplace have a significant influence on problems that have been given in regard to video display terminals. We feel that lighting, seating, and placement of the equipment will all help.

The video display terminal is, in our industry, a very important device We are constantly changing it. Newer approaches to VDT use involve video display makeup of pages, and electronic makeup. As such, we are starting to use devices that do not always use CRT's. We were the first industry to use plasma displays. We are dealing

with the data in ways that do not involve the same kind of intensity that a clerical use of the equipment would require

We are using alternate forms of control rather than the keyboard We are using devices called mice, digitizing pins, joy sticks, and track balls to make up pages electronically. So our industry is using our equipment uniquely It is a large industry of small users and an industry with a large installed base of older equipment.

Mr. Romano noted that some VDTs are already marked with plasma displays. The power needed for plasma displays can be generated by a common battery.

Mr. Romano noted that ergonomics has been learned in using VDTs: Some users initially placed their units near the glare of windows. The witness also considers VDTs a probable comfort improvement over the Lino type machines used by this industry. Such machines had a fixed keyboard—lacking adjustment.

Mr. Vico E. Henriques, President of the Computer & Business Equipment Manufacturers Association addressed the Subcommittee.

The CBEMA witness said that there is not really a health and safety issue in the use of computer equipment in offices. There is a comfort issue.

CBEMA offers this advice to managers who may not be aware of proper computer office practices.

If work has been restructured as a result of new equipment, users need to understand where their new career paths lie.

If paper systems have been replaced by electronic information, then the office probably needs physical modification.

The lights from the old office may to too bright.

The noise level may now be so low that people need a "white noise" system for privacy.

Sunlight through the windows may be creating glare on VDT screens.

People who've been avoiding glasses by holding paper close to their eyes now discover that, since they can't move the terminal, they need to get a prescription.

Users may now be moving around so little that they need to take breaks specifically to get some exercise.

The CBEMA representative stressed that these problems are easily corrected.

Mr. Henriques also noted problems with proposed regulations. These would include:

Forcing people to sit in special chairs, even if they were satisfied and comfortable in the present model.

Mandating covers for windows with blinds even if there were no glare problems, or even if the glare problems came from another source.

Forcing low light levels in all workplaces using visual displays, even though such levels might pose problems—such as on a factory assembly line—or in a hospital.

Reducing the number of hours people could work on displays to a maximum of four or five, ignoring the fact that millions of users would be forced out of full-time jobs and into half-time jobs.

Forcing employers to pay for meaningless devices and activities such as metal shielding for terminals and radiation inspec-

tions. Channelling funds into useless items simply raises the cost of products.

Mr. Henriques stressed that with education, people have the freedom to choose solutions to problems that are best for them as individuals, while legislative mandates force citizens to conform to a legislator's best guess.

Findings and Conclusions

The rapid expansion of video display terminals in the workplace clearly suggests that employers and employees must work together to resolve many of the stress-caused problems. It is unlikely that legislative action at any level will do more than provide contradictory and, perhaps, more restrictive limits rather than encouraging the flexibility that is both desirable and necessary for worker health and safety in offices and other locales where VDTs are in prevalent use.

As noted, all witnesses agree there are some workplaces where comfort is a real issue. Physical comfort, though, will be difficult to legislate. Providing the right kinds of equipment, furniture and fixtures, lighting and window coverings, and so forth, are ideally and realistically issues that must be resolved in each individual place of employment.

If one reviews even briefly the variations in screen color of VDTs as prescribed by European standard setters, one finds a wide range. This clearly implies that there are no single "best" or "better" standards, at least insofar as video screen color backgrounds are concerned.

The same seems to be a reasonable conclusion in terms of office furniture and fixtures. A chair that is adjustable in terms of height, back position, arm rests, and other elements is not going to be comfortable for everyone. There are some workers who would rather have a hard-backed, straight chair. Others would rather have a standard secretarial chair. To attempt to force a standard system on everyone seems excessively restrictive.

There is a real queston when it comes to determining the physical stress of using a VDT for a long period of time This stress often manifests itself in the form of headaches, eye strain and other ailments. There is little doubt that, as many witnesses testified, more frequent breaks may reduce the ailments caused by this stress.

As many of those witnesses indicated, it is not so much the need for a clear break from work that is important as much as it would be a change in activity. Here again, it would be difficult at best to set in legislatively mandated terms a standard for breaks. If workers feel rest breaks are necessary, what constitutes a reasonable break—a 15-minute break for each hour spent using a VDT? Should there be a 15-minute break for every two hours in front of the VDT screen?

Is the Congress or any other legislative body prepared to tell an employer that an employee must be given other tasks to do as a form of respite from VDT work?

After reviewing the broad range of testimony presented to the Subcommittee during the course of its hearings, it appears that

these ergonomic factors are not the kind that could be legislatively standardized. Rather, it is an issue that must be resolved in the workplace itself between employers and employees.

Reasonable employers will recognize the value of coming to terms with the realities of the situation. In workplaces where employees are organized into some form of bargaining unit, the employees can more easily encourage the employer to adapt a more flexible approach to the introduction and usage of VDTs.

Although it was not a particular subject of the hearings, it is apparent that some of the stress connected with the use of VDTs has to do with the way the video display terminals were introduced into the workplace and the kinds and amounts of training provided by employers for those who would be using the equipment.

It seems reasonable to expect that employers would make every effort to have employees understand the reason for either introducing VDTs into the workplace or for expanding the use of VDTs so that employees would not feel threatened, fearing excessive production standards would be in place or the possibility of more monitoring of their work.

Much of the testimony presented during the Subcommittee hearings focused on potential and possible hazards posed by radiation emissions from VDTs. Clearly, the overwhelming body of scientific evidence at this point in time gives little credence to the radiation concerns expressed. This is especially true in respect to the effects of radiation from VDTs in connection with reproductive problems and eye problems such as cataracts.

The body of research indicates that there are no emissions which can cause cataracts. The American Academy of Ophthalmologists went so far as to say that regularly mandated eye examinations are not necessary for VDT operators. Regular eye examinations had been recommended by NIOSH and labor organizations. However, the issue of regular eye examinations, too, would be something for discussion between employer and employees.

Of more concern to most witnesses than the issue of causing cataracts was the question of possible radiation emissions from VDTs that could cause reproductive problems, most notably spontaneous abortions and birth defects.

In 1979, four women who had worked at VDTs at a Canadian newspaper office had babies with birth defects. Several other confirmed clusters of birth defects or spontaneous abortions associated with VDT work during pregnancy have also been reported. All of the reported clusters have been small; the largest consisting of 13 problem pregnancies. Of more import; many different types of birth defects have been reported, suggesting that these problems did not have a common cause.

Canadian and U.S. government agencies have studied several individual clusters in detail and concluded that there was no indication that VDTs were at fault. Experts from the Food and Drug Administration's Center for Devices and Radiological Health also reviewed several clusters and reached the same conclusion.

Medical researchers indicate that if there were any emissions that might be of a level to cause harm, the tendency would be for a strong similarity in birth defects. This, those researchers say, has

been the most traditional way of isolating a single source as the casual element.

Researchers from the Centers for Disease Control, for example, who investigated a cluster in which eight pregnancies had adverse outcomes, estimated that the likelihood of such a cluster was six in 1,000.

The National Institute for Occupational Safety and Health is currently undertaking an epidemiological study on the effects of VDT use on reproductive health. The study will involve both VDT users and non-users over a three- to four-year period. This kind of study is vital and its results could have far-reaching effects in reducing the fears of pregnant women using VDTs.

One suggestion offered during testimony was that pregnant women who use VDTs on a regular basis should be allowed to transfer to other duties during the course of their pregnancy. This issue, again, is one to be decided in each individual workplace, between employer and employee.

Another area in which additional study is needed is on the possible effects of low-frequency non-ionizing radiation. Current scientific knowledge seems weakest in terms of the effects of very low and extra low frequency radio waves that emanate from VDTs. Laboratory and other research studies are needed in this area to further examine any possible effects.

This additional research, like the NIOSH epidemiological study, is necessary to provide that body of knowledge which, if it indicates no hazard, will reduce or eliminate the stress on VDT operators who fear for their health.

APPENDIX A

WITNESS LIST

Ms. Jackie Ruff, Executive Director, District 925, Service Employees International Union, AFL-CIO/CLC
Ms. Rebecca Alford, Representative of District 925, Service Employees International Union, AFL-CIO/CLC
Mr. Charles A. Perlik, Jr., President, The Newspaper Guild, AFL-CIO
Mr. David J. Eisen, Research and Information Director, The Newspaper Guild, AFL-CIO
Dr. Arthur L. Frank, M.D., Ph.D., Professor and Chairman, Department of Preventive Medicine and Environmental Health, University of Kentucky College of Medicine
Mr. David LeGrande, Occupational Safety and Health Department, Communications Workers of America, AFL-CIO
Mr. Stephen D. Channer, Executive Director, Business and Institutional Furniture Manufacturer's Association (BIFMA)
Dr. Charles N. Abernethy, Manager of Human Factors, Digital Equipment Corp., on behalf of The American Electronics Association
Dr. Max M. Weiss, Group Supervisor, Radiation Protection Group, AT&T Bell Laboratories, on behalf of the American Electronics Association
Dr. Marcus B. Bond, on behalf of the American College of Obstetricians and Gynecologists
Dr. William L. Rich,
Dr. Martin Mainster, and
Dr. Alfred Sommer, all on behalf of the American Academy of Ophthalmology
Dr. J. Donald Millar, Director, National Institute for Occupational Safety and Health (NIOSH)
Dr. Philip Landrigan, Director, Division of Surveillance, Hazardous Evaluation and Field Studies, NIOSH
Dr. Barry Johnson, Director of Biomedical and Behavioral Studies, NIOSH
Dr. Howard Brown, Medical Director, New York Times; Chairman, American Newspaper Publishers Association (ANPA) Environmental Committee
Mr. George Cashau, Director of Technical/Research, ANPA
Mr. Richard Neergaard, Assistant Environmental Coordinator, ANPA
Mr. Frank Romano, Associate Publisher, Typeworld; Chairman of Printing Industries of American National Composition Association
Mr. Mark Killmon, Technical Director, National Composition Association

Mr. Vico E. Henriques, President, Computer and Business Equipment Manufacturers Association (CBEMA)

Additionally, the following organizations submitted statements for the record:

Air Transport Association
American Federation of State, County and Municipal Employees
American Society of Travel Agents, Inc.
Coalition for Workplace Technology
Metal Trades Department, AFL-CIO
Office and Professional Employees International Union, AFL-CIO

SYNOPSIS OF TESTIMONY BEFORE SUBCOMMITTEE

1. MS. RUFF, ON BEHALF OF THE SERVICE EMPLOYEES INTERNATIONAL UNION, AFL-CIO/CLC, AND 9 TO 5, NATIONAL ASSOCIATION OF WORKING WOMEN

Our union represents over 90,000 clerical workers in the public and private sector. In 1981, the Service Employees joined with 9 to 5, National Association of Working Women, a membership organization of more than 12,000 women office workers and 17 chapters nationwide, to create the office worker affiliate of SEIU, District 925. Both SEIU and 9 to 5 are concerned about the daily problems workers face with the introduction of new office technologies.

Office automation is skyrocketing. The National Academy of Sciences has estimated that more than 7 million Americans currently use VDTs. Business experts predict an increase of users to 40 million by 1990.

Last May, 9 to 5 set up a toll-free hotline. They were convinced that information from VDT operators who called the hotline would be of great importance in pinpointing problem areas.

More than 6,000 people called the hotline in the six months it was in operation. A total of 873 VDT operators filled out and returned health history/job history surveys. Results of this national survey of self-selected respondents include a United Airlines group of pregnancy problems and also a wide range of health symptoms among all respondents.

Taken as a whole, the questionnaires reveal a personal health profile for the VDT operator which is truly frightening. The average respondent is female, works 6 to 8 hours daily on a plastic-cased VDT, her eyes 10 to 20 inches from the VDT screen, without rest breaks other than those given to all other workers.

The majority of respondents "often or daily" experience eyestrain (53.5%), exhaustion (51.6%) and/or muscle pain (56.2%).

Of all respondents, 48% report diagnosis or treatment by a physician since working with VDTs for vision problems or changes in eyesight. 19.2% report treatment for gastritis or nervous stomach, and 14.9% report diagnosis or treatment for high blood pressure.

Most troublesome of all, when questioned about reproductive health histories, VDT operators who reported becoming pregnant since working with VDTs could claim only a 31.6% rate of normal, full-term delivery. Because of the self-selected nature of 9 to 5's survey respondents, it is not possible to say that this percentage applies to all VDT operators. But it is possible to say that the scope

and number of reported pregnancy-related complaints is shocking enough to demand immediate action.

Since the hotline opened, 9 to 5 has received reports of at least 15 VDT work environments with multiple miscarriages, birth defects and other pregnancy problems. 9 to 5's investigation of the United Airlines office revealed a rate of pregnancy-related problems which seem especially compelling.

At the United Airlines office in San Francisco, where approximately 300 workers sit in front of VDTs for up to 8-10 hours per day, employees reported a 50% rate of problem pregnancies in the last four years. Out of 48 pregnancies, 24 ended in either miscarriage (15), birth defects, still-birth or neo-natal death, premature birth and other problems.

9 to 5 has helped United employees to file a Health Hazard Evaluation Request (HHE) with NIOSH. 9 to 5 has asked to be an acknowledged third party in this investigation.

But this is not nearly enough. Every worksite with reported pregnancy problems should be scientifically investigated and evaluated. Every possible cause of the unexplained pregnancy problems must be looked at closely, and solutions found. Possible paternal effects on male VDT workers must be included.

No protections exist in the U.S. to safeguard workers from possible adverse health effects associated with VDT work.

Taken singly, any of the already confirmed clusters in the U.S. and Canada could be dismissed as statistical quirks. But these problems continue to surface and more evidence mounts. The health problems documented through the VDT hotline mirror the findings from other studies such as the recently completed Newspaper Guild/Mt. Sinai study and earlier NIOSH studies of health complaints among VDT operators. 9 to 5's new reports of 15 more possible problem areas, however, makes it impossible and irresponsible to dismiss this situation without more action.

SEIU has acted on our members' concerns about the health and safety risks associated with VDTs through collective bargaining. For example, contract negotiations between an SEIU local and the City and County of San Francisco recently covered VDTs. This contract establishes the union's involvement with management to confer on ways to design the flow of work to avoid long, uninterrupted use of video display equipment by employees. The contract further provides a labor-management committee to review eye examinations, required rest breaks of at least fifteen minutes after two hours of work, effective glare screens and adjustable chairs, optimal lighting, transfer rights for pregnant employees, and prior notification and consultation in the event of layoffs.

While collective bargaining efforts have afforded SEIU members some modicum of protection, we believe that state and federal legislation is necessary to supplement union efforts and to provide a floor of protection for workers not covered by union representation. Therefore, both SEIU and 9 to 5 have actively supported state legislation on VDT safety that has been introduced in Massachusetts, Illinois, New York, Oregon, Connecticut and Rhode Island.

When such legislation has been considered, we have recommended that the standards for safe use of VDTs include:

The right of workers to transfer away from VDT work to other work within the company during the course of pregnancy, without loss of pay, seniority or benefits.

Safe VDT equipment for all workers by the manufacturer through the use of inexpensive metal shielding. Machines already in use should be retrofitted with shields in order to eliminate any possible radiation emissions.

A minimum rest break of 15 minutes for every 2 hours of VDT work, or 15 minutes for every hour of intense VDT work.

VDT equipment with adjustable screens, keyboards and glare-reduction devices; and furniture, lighting and work environments designed for the comfort and safety of the operator. Employers should provide regular eye examinations for all VDT workers.

Elimination of stress-inducing features of automated jobs such as machine pacing or computer monitoring.

Periodic, thorough testing of VDTs for X-ray emissions, as well as regular maintenance schedule.

Further research into all potential health hazards of VDTs without delay.

In response to the hotline findings, 9 to 5 has called on NIOSH to: thoroughly investigate the possible cluster of problem pregnancies at United Airlines immediately; to follow through on the feasibility study of pregnancies among women workers, including VDT users, and to begin actual study, with full funding, as soon as possible; and to set up a national tracking system to study patterns of VDT-related health problems across the United States and recommend solutions.

2. MS. ALFORD, ON BEHALF OF DISTRICT 925, SERVICE EMPLOYEES INTERNATIONAL UNION

I am employed as a VDT operator at the Equitable Life Assurance Society in Syracuse, New York.

The Syracuse equitable office looks and operates like a factory. There are 70-some clerical workers, primarily women of childbearing years, who work from 8 to 10 hours a day, sitting in long rows at impersonal work stations dominated by video display terminals. In our office we process medical and dental insurance claims. We have only a lunch hour and one 15-minute break in which we are not rigidly glued to the screen.

Although management originally presented the VDTs as new toys to make our work lives easier, it soon became apparent that Equitable's method of introducing automation and lack of concern for our health enslaved us to the new machinery and subjected us to health and safety hazards.

When Equitable coverted from a paper to a computer system, employee input into design of environment, work station and the job itself was never—and still is not—considered. VDTs were introduced with no apparent regard to worker safety and health, job satisfaction, career mobility or job security. Management in our office did not know how to use the VDTs, nor could they envision what problems would arise. Consequently, we were left to master it ourselves. Made to work on a system that determined the pace and

content of our work, we were stripped of any autonomy or job satisfaction.

We asked for information on safety and health risks and were assured there were none.

I was pregnant at the time and concerned that possible dangerous levels of radiation emissions from the VDT combined with a highly stressful job could affect the health of my unborn child. I was told that such questions would just lead to unnecessary trouble in the office.

My fears about the dangers of VDTs to pregnancies have unfortunately proved to be well-founded. Recently I gave birth to a child with multiple defects. I cannot help but think there is a connection. Though other pregnant women in the office have so far been spared this tragic consequence, a signficant minority of pregnancies have resulted in miscarriages.

Many of us have noticed the deterioration of our vision since working on the terminal. Some have had to wear corrective lenses for the first time. Others have had their prescriptions strengthened. One employee was told by her ophthalmologist that he is sure her recent eye problems were caused by prolonged exposure to the cathode ray tube, but that he had no way of proving it. At home, after a day on the tube, I have a difficult time focusing on close objects. My eyes frequently tear and sting. Only after a weekend away from the terminal do my eyes begin to feel better.

In our office the windows cannot be opened. The intense heat of the VDT combined with dirty air creates a strifling environment. Simple requests to clean the curtains to remedy some part of the problem have been denied and many employees consequently suffer from dry, flaky skin, rashes and light-headedness.

Back and neck problems abound, a result of tubes, chairs, and desks that we cannot adequately adjust, and of long hours sitting in one position. Getting up and moving around during the day to alleviate cramping and stiffness and give our sore eyes a rest is discouraged, and in fact, is penalized, since our machines are electronically monitored for productivity.

The lack of control over our jobs combines with demeaning, boring work, assembly-line conditions, safety and health risks to ourselves and our children, and unsupportive bosses to result in a highly stressful situation for clericals at The Equitable. One VDT operator is frequently awakened from sleep by nightmares associated with her work. Many suffer from depression, irritability, nervousness, and other stress-related disorders.

3. MR. PERLIK AND MR. EISEN, ON BEHALF OF THE NEWSPAPER GUILD

The Newspaper Guild represents some 40,000 news and commercial-department employees of newspapers, news services, magazines and related enterprises in the United States, Canada and Puerto Rico.

Our members, principally our reporters and copy editors, were perhaps the first sizable group of employees to be confronted with video display terminals, a decade ago. They were novelty then, but today there are more than 46,000 in U.S. newspaper offices, and it is the typewriter, not the VDT, that is a rarity. There are few

newspapers of any size that have not converted their newsrooms to VDTs and the computerized systems of which they are a part, and the terminals are moving with increasing rapidity into classified-advertising, circulation and business offices, as well.

We are not, any longer, alone. There are now an estimated seven million VDTs in offices across the country, and business experts predict there will be close to 40 million by 1990. Our problems are becoming everybody's problems.

Those probiems, in the area of the operator's health and well-being, began to surface in our ranks very early, and they have multiplied to proportions that would have astounded us, in our innocence, a dozen years ago.

Our members began to complain quite early of eyestrain, of visual fatigue, of headaches, of dizziness, of nausea, of body aches and pains, and those complaints continue unabated.

Our Wire Service Local, representing employees of AP and UPI, polls its members from time to time on various shop and contract problems. In its most recent poll, three years ago, 50 percent of the UPI employees responding said they had visual problems after working on VDTs, and 40 percent said they usually went home with headaches. Thrity-six percent of the AP employees reported visual problems and forty-five percent said they went home with headaches. And it should be kept in mind that many of those responding are correspondents, who, unlike copy editors, work only part of the time on VDTs.

Complaints had grown to such porportions that we were moved to hold a Guildwide conference on the problem in 1976. Shortly thereafter we issued a VDT Health Collective Bargaining Kit to guide our Locals in negotiating contract clauses that would ameliorate the most serious VDT problems. The kit consisted principally of three articles incorporating the results of research on VDT health problems by European VDT authorities; we were far behind in this country, and at that time such research was barely getting underway on this side of the Atlantic.

In 1979 our locals in the San Francisco Bay Area joined with locals of the Typographical and Office Employees' unions in organizing a coalition of unions that asked the National Institute for Occupational Safety and Health (NIOSH) to make a study of VDT health effects in their shops. In response, NIOSH went into the San Francisco Chronicle and Examiner, the Oakland Tribune and the San Francisco Blue Shield offices in 1980, surveyed the conditions under which VDT operators were working and administered a questionnaire to both operators and non-operators to determine health effects and stress levels. The results were noteworthy.

At the newspapers, NIOSH found significantly higher incidences of eyestrain, burning eyes and sore shoulders among operators than among non-operators in San Francisco, and significantly higher incidences of eyestrain, sore eyes, pains or stiffness in the limbs, swollen or painful muscles and joints and, into the bargain, greater anxiety, depression, irritability, tension and other indications of stress in Oakland. We pointed out, in commenting on NIOSH's draft reports, that these findings almost certainly understated the problem, because a large percentage of the VDT opera-

tors included in the survey were reporters, who work on VDTs only intermittently.

This contention, as well as NIOSH's own belief that VDT problems are more acute in the case of employees engaged in routine jobs, was strikingly confirmed by the results of NIOSH's study at the Blue Shield offices. There NIOSH found VDT operators suffering from significantly higher levels of eye strain, blurred vision, burning eyes, color-perception problems, neck pains, sore shoulders, arm and leg pains, back pains, sore wrists, hand cramps, numbness and loss of arm strength, not to mention higher levels of fatigue.

Based on its findings in San Francisco and on research elsewhere, NIOSH produced a series of general recommendations on VDT health and safety. They are the first step toward an occupational health standard for VDTs.

As we began to devote our attention to these visual and musculoskeletal problems, however, there were new and more startling developments. In 1976, two of our members operating VDTs at the New York Times developed cataracts. They were 29 and 35 years old. far below the age at which cataracts normally develop. The opacities were diagnosed as radiant-energy cataracts by Dr. Milton Zaret, an authority in the field, and the possibility arose that radiation from the VDTs might have been responsible.

We had eight similar cataract cases reported from our ranks in the five years that followed. When two developed at another site, the Baltimore Sunpapers, the Guild asked NIOSH to come in and conduct an ophthalmological study. It did, and, while it found no greater incidence of cataracts among VDT users than among nonusers, it said the VDT operators had not been working on the tubes long enough for the study to be conclusive. It did conclude that "the bothersome visual aspects of the VDT itself . . . explained the plurality of work-associated symptoms"—headaches, burning eyes and blurred vision reported by many of the VDT users NIOSH surveyed.

Even more disturbing was the revelation, in 1980, that four of seven women who gave birth in a one-year period during their employment as VDT operators in the classified-advertising department of the Toronto Star had children with birth defects. There have been at least seven other confirmed clusters of birth defects and miscarriages, mostly miscarriages among VDT operators since then, and concern has run high among our own members and female VDT operators generally throughout the United States and Canada.

Radiation, of course, is again the prime suspect here, and while X-radiation and microwaves are so low as to be excluded as a likely cause, two forms of radiation known to be emitted by VDTs, Very Low Frequency and Extremely Low Frequency radiation, have been suggested by reputable scientists as possible causes of reproductive problems among VDT operators, should the existence of these problems be confirmed.

That, of course, is the big question, in regard to cataracts as well as reproductive problems, and it was with a view to helping resolve it that we and the Mount Sinai School of Medicine embarked on the study whose initial results will be reported for the first time, at today's hearing.

Mount Sinai joined us in preparing an elaborate questionnaire on the health effects of VDT operation, and it was distributed to more than a thousand employees, both VDT operators and control groups of non-operators, in six Guild Locals—Hawaii, Memphis, St. Louis, Southern Ontario, Vancouver-New Westminster and our Wire Service Local. It is one of the largest studies of its kind to be conducted to date.

4. DR. FRANK

Our review of the scientific literature, and further discussions with colleagues, revealed that there was a great paucity of scientific information with regard to possible health effects related to VDT exposure. The broader area of non-ionizing radiation had few studies published, and much of the scientific information available had to do with very basic laboratory investigations, with very few investigations on humans, and even fewer which might best be called epidemiologic studies. With agencies such as NIOSH estimating that at least seven million Americans operate VDTs at their workplace, the potential for large numbers of people being affected, should health problems be found, was clearly evident.

There were a number of medical issues that have been suggested as potential health problems in this area. There were concerns about the effects of VDTs on the eyes, both in terms of short-term effects, and to the potential for the long-term development of cataracts. There were increasing numbers of reports of young women suffering reproductive misfortunes which might have an association with their employment using VDTs. Studies of other exposures to non-ionizing radiation in animals suggested other potential medical disorders. With so much to consider, and with no human data from any substantial group available, it seemed appropriate to begin with a broad based hypotheses generating study.

The conduct of research in human populations is difficult and has many problems. Among the greatest difficulties is the identification and subsequent enrollment of a suitable population. What happened in this case was that our own scientific interest and the interests of a group of individuals exposed to VDTs coincided in a manner that made this research possible. As those of us at Mount Sinai developed our interest in this field, The Newspaper Guild was developing its interest because of widespread use of such equipment in the newspaper industry. A series of discussions and interactions led to the development of a study which we are here to report on today.

Six locations were selected for this study. Criteria for selection included a sufficiently large population at that site of both VDT users and non-users, willingness of union leadership at those locals to participate, and the likelihood that concurrent eye examinations could be arranged. The study locations were Memphis, St. Louis, Toronto, Vancouver, Honolulu, and The Wire Service local in New York City. It was hoped that sufficient data would be developed at each site which would allow individual statistical analysis as well as evaluation of group data. This allowed for findings to be generalized.

The rate of return for the six locations varied between 18% and 52%, with more VDT users responding than non-users. In some locations we were able to identify the number of users and non-users in the overall population, but in others it is unclear what the percentages were, although the best estimates were that approximately 60% of those to whom questionnaires were circulated were VDT users, while 40% were not. Of the returns, 74% were from users and 26% from non-users. There was a total of 1,109 questionnaires returned. Not all of these questionnaires provided useful data since there were some individuals who refused to participate and returned a blank questionnaire. Ultimately, 1,047 useful questionnaires were collected from the six locals. Although a higher response rate would have been better, I believe that this response of over 1,000 userful questionnaires is one of the largest bodies of such data available.

The questions asked covered several major areas. These were (1) effects on eyes, (2) musculoskeletal effects, (3) reproductive effects, (4) characteristics of the workplace, (5) stress and other personal feelings. There were also questions about skin rashes, a variety of routine medical problems, smoking history, educational level, and questions about VDT and microwave oven use.

When all available questionnaires were analyzed. positive findings were noted for some eye problems, musculoskeletal disorders, characterization of the workplace, and in the area of stress and personal feelings. The data were inconclusive with regard to reproductive effects. In addition, there was an interesting finding with regard to time lost from work.

Complaints of eye problems from VDT operators were found to be generally consistent across the various sub-groups. VDT users suffered more from deteriorated vision, eye strain, eye irritation, red eyes, and blurred vision than non-users. This was in contrast to questions about other senses such as taste or smell where no differences were found. As a group, the vast majority of individuals, among both users and non-users, wore eyeglasses. Most respondents had at least one prescription change in the period covered by the questionnaire and there were no significant differences in the number of prescription changes. Likewise, questions were asked about both cataracts and precataract conditions.

The number of respondents precluded making any firm conclusions about the development of cataracts since the problem is uncommon, and tends to occur in older individuals.

The questionnaire evaluated certain musculoskeletal problems. VDT users, more than non-users, suffered from neck pain, shoulder pain, and low back pain. These findings were statistically significant, that is, could not be explained by chance.

Headaches were significantly more frequent among VDT users when compared to non-users.

Reproductive questions were asked about at some length. Since the population needed to be subdivided by sex, age, and marital status, few individuals were left for appropriate statistical analysis in any one category. Therefore, no conclusions can be drawn with regard to reproductive effects and VDT exposure since the number of birth defects and miscarriages were insufficient in this size population. Of some interest, however, was that although males repre-

sented a minority of the study population, they reported more birth defects among their offspring than did the working women.

There was no evidence of premature birth, infant mortality, or effect upon the menstrual cycle with VDT use.

VDT workers reported being more irritable, having trouble sleeping, having trouble getting up and feeling overworked. Neither group commented on problems related to excessive supervision or monotony.

In addition to VDT users reporting on stress and physical difficulties, they also reported more often on problems of physical design at the workplace. VDT users noted more often than non-users problems with reflections, improper brightness, how one sits, and poor equipment.

There were no differences reported with regard to skin rashes, although this has been reported elsewhere.

Another finding of some interest was that while there were no differences between users and non-users with regard to frequency of seeing a physician, or for hospitalizations, VDT users lost more time from work than did non-users. Statistically significant, more VDT users were absent from work three or more times in the preceding two year period than non-users. For those reporting on total days lost from work over that two year period VDT users were absent more than one-half day longer on average than non-users. While a small difference, if this is multiplied by the millions of workers involved, the dollar cost each year in lost time wages is quite large.

Although there were some methodological problems with this study, the findings are consistent with earlier reports from NIOSH and other investigators. Problems with vision and ergonomic difficulties have been noted elsewhere. In addition, the recently released National Research Council report on video displays and their effects on vision commented on the need for further investigation.

As an outcome of this study, we have made several conclusions and would offer several recommendations. First, working with VDTs clearly produces problems with vision, with musculo-skeletal disorders, and produces stress related findings. By way of corroborating evidence, there are complaints about the physical aspects of the workplace. Secondly, questions with regard to the development of cataracts remains unsettled. It might be that insufficient time has elapsed since the widespread use of VDTs at the workplace has occurred to allow for proper evaluation of this problem. Clearly, however, it is an area that requires additional research. Thirdly, the question of reproductive effects remains unsettled. NIOSH has suggested that an appropriate study, among women of reproductive age, be undertaken. While this is not yet a reality, we would strongly endorse such an investigation.

In light of our findings we would recommend: (1) additional research with regard to health effects of VDT use be supported (2) an interim standard on work breaks be instituted while (3) studies are undertaken to develop the optimal schedule for such work breaks (4) that workers using VDTs receive regular eye examinations and (5) that there be further investigation of the question of lost time from work related to VDT use.

5. MR. LE GRANDE, ON BEHALF OF THE COMMUNICATIONS WORKERS OF AMERICA, AFL–CIO

CWA represents more than 670,000 workers in both the private and public sectors throughout the United States. Over 350,000 of these workers utilize VDTs to perform their jobs.

Studies conducted by and for CWA have demonstrated that vision problems are the most frequently mentioned member health symptoms. These studies discuss VDT problems of CWA members who work for many different employers in varying locations within the United States. They indicate different types of visual discomfort may produce varied effects. For example, severe optical discomforts such as eye irritation, soreness, and tiredness may not go away within a short period of time following work and may even be present at the start of the next day's shift. Health effects related to visual performance like blurred vision may have a recovery period of 15–20 minutes or more. These visual problems may be most pronounced among VDT operators 40 years of age and above.

Due to the causal relationship between VDTs and eye discomfort and, possibly, permanent visual deterioration, workers should be provided eye examinations upon commencement of employment or assignment of work upon VDTs and annually, thereafter.

Postural or musculoskeletal problems are common to many VDT jobs. Operator complaints are most often related to the neck, shoulders, back, and wrists. Complaints mentioned less often involve the arms, hands, and legs. Researchers indicate musculoskeletal symptoms are more frequently reported by VDT operators than workers in traditional office jobs.

Along a similar line, data from union-sponsored or conducted studies indicate that, next to visual and ocular complaints, musculoskeletal complaints are the second most frequently reported member health symptoms.

There are several common characteristics of VDT jobs that have been related to increased musculoskeletal complaints. These include the design of the VDT and workstation equipment, the nature of the task, the degree of postural constraint, work pace, repetitiveness of the job, work and rest break schedules, and personal attributes of workers. All of these factors must be addressed to effectively reduce reported VDT operator musculoskeletal health complaints.

During the last several years, the subject of radiation emissions from visual display terminals/cathode ray tubes has become a major concern to workers. Of particular interest is the question of whether there is a link between VDT exposure and birth defects and spontaneous abortions. This concern has arisen as a result of the identification of several clusters of reproductive problems among VDT operators.

One NIOSH-designated cluster involves CWA members. Two additional "unofficial" clusters also are made up of members of CWA. Although some scientists have suggested that the reproductive clusters are not related to VDT radiation emissions, other scientists have produced data or have raised serious questions regarding the validity of these conclusions. In several cases, pregnant members have put their jobs on the line rather than risk potentially harmful

radiation exposure. Although the suggestion of granting pregnant workers transfers to work not requiring the use of VDTs or leaves of absence during the term of pregnancy have been made, these approaches do not address the real issue of whether there are harmful levels of radiation emitted by VDTs.

Until such time as conclusive scientific data is collected, VDT operators should not have to wonder if exposure would result in negative health symptoms. Manufacturers and employers should be ensuring that workers are not exposed to harmful radiation levels. In part, this can be accomplished by having manufacturers build VDTs with metal cabinets and installing metal shielding on radiation-emitting devices within VDTs. In addition, employers should be held responsible for retrofitting machines currently in use with metal shielding.

Another issue that has recently been raised is the relationship between the possible inhalation of polychlorinated biphenyls (PCB's) from VDTs and reproductive disorders. Additional scientific work needs to be performed to confirm or negate existing scientific findings.

In large part, a discussion on VDT design might also be thought of as a discussion on ergonomics. Ergonomics, or human factors, as it is commonly referred to in the United States, is the study of the relationship between human beings and the work process and environment.

VDT visual, musculoskeletal and job stress health complaints occur as a result of poor VDT work station, workplace and work organization design. In order to remedy the health problems associated with VDT work, all design factors must be considered.

Ideally, VDT design controls should be placed into the equipment during the manufacturing process. Manufacture and use of ergonomically designed VDTs will result in lower long-term costs, increased productivity, and decreased worker health symptoms.

VDT design factors include separable keyboard and screen equipment, reflectance quality of the screen, adjustable screen angle, sharpness and brightness controls, screen and character size, and appearance of the equipment.

Of utmost importance, employers should establish a biannual schedule for VDT maintenance. Scientific data clearly demonstrates that poorly maintained VDTs may produce distorted screen characters and promote worker health symptoms.

Variables important to VDT work station design include the VDT table, chair, document holder, lighting, footrests, and arm and wrist rests. An important factor of proper VDT workplace design is flexibility. VDT tables, chairs, document holders, task lighting, foot, arm and wrist rests should be designed to allow for operator adjustment.

In addition, all too often, VDT equipment is installed in traditional offices with little or no redesign of the workplace. In many cases, workers have witnessed the implementation of VDTs into their work environment without proper consideration of ergonomic factors.

The proper amount of workplace illumination is essential for VDT work to be performed without visual discomfort and fatigue. Improper illumination is characterized by scientists as a major

cause of operator visual, musculoskeletal, and job stress related health symptoms. In general, researchers suggest that VDT workplace illumination levels should be much lower than in traditional offices.

VDT workplaces should be engineered and maintained to provide comfortable temperature and humidity levels. Proper spatial design of the workplace, maintenance of temperature and humidity controls, and prevention of wide variations in temperature will help reduce illnesses and lost-work time and help increase worker morale, efficiency, and productivity.

Experts in the field have reported another workplace design concern—noise.

VDT workers should be provided frequent, short breaks, to reduce fatigue and physical stress. For jobs that require more than sixty percent viewing time, constant, rapid muscular action, fixed postures for extended periods of time, or that are highly repetitive and boring, breaks of fifteen minutes every hour should be provided. VDT jobs with less stringent requirements should contain breaks of fifteen minutes every two hours.

CWA has utilized the collective bargaining arena to bring about more healthful VDT working conditions for its members. For example, in 1983, CWA and American Telephone and Telegraph negotiated preliminary guidelines for selection, installation, and use of VDTs. The guidelines, written by Bell Laboratories and reviewed by CWA, cover work station and some factors of workplace design. Some 250,000 VDT operators are employed by the concerned companies. This agreement is currently in effect for American Telephone and Telegraph and the now-divested Bell System companies.

The federal government should act to ensure that all employees are provided safe and healthful VDT working conditions. The CWA urges the Subcommittee to fulfill its mandate by assisting workers in their efforts to bring about safe and healthful VDT working conditions. To accomplish this, the Communications Workers of America requests that the Subcommittee:

Encourage NIOSH to initiate comprehensive research regarding potential health hazards associated with VDTs. Such research should include all visual, musculoskeletal, job stress, and reproductive hazards.

Encourage the Bureau of Radiological Health to establish specific standards both for the manufacture of VDTs, and for VDTs currently in use.

Consider the adoption of legislation specific to VDT work environments. Such legislation should provide for the duration of work periods, visual testing, ergonomics, job stress, research and protection from potential reproductive hazards, and worker participation in the introduction and use of visual display terminals.

6. MR. CHANNER, ON BEHALF OF THE BUSINESS AND INSTITUTIONAL FURNITURE MANUFACTURER'S ASSOCIATION

The Business and Institutional Furniture Manufacturer's Association (BIFMA) is a trade association whose members represent

over 90% of the total office furniture industry sales volume. Our members are located or operate in every state in the union.

Since BIFMA's founding ten years ago, we have been in the forefront of safety. Our members, who manufacture office furniture, have consistently demonstrated over many years a concern for the health and safety of the office worker. We have a strong record of safety. We have developed six product safety and performance standards to insure that we continue to produce safe and durable furniture which is correctly designed and manufactured for whom our founder termed the "captive consumer," the person who has had little or no voice in the environment in which he or she works.

We wrote flammability standards to insure that our products maintain one of the highest safety records for fire safety. We are now going even further to be sure that even in the unlikely event of fire in the office, that the smoke generated will not contain potentially toxic gases. We also actively support cigarette safety measures that may help prevent thousands of fires from ever starting.

Our Building Code Standards Committee prepared an addition to the National Electrical Code for the National Fire Protection Association, that provides for safe electrical wiring for office furnishings.

The General Services Administration counts on BIFMA to develop the most appropriate safety and performance criteria for furniture to be purchased by the federal government. Through the active promotion of the use of these standards, we see now that many purchasers and designers are relying on the standards to insure the safety of the products found in offices.

In September, 1983, BIFMA sponsored the first ever inter-disciplinary symposium on the human factors of office design. Experts in subjects such as ergonomics, lighting, acoustics, office automation, and human resources participated. The symposium acted as a forum for information exchange and comment and provided a reference point from where further in-depth examination of specific subjects can proceed. The purpose of the symposium was to provide a forum for interested parties to express their individual or collective concerns in a positive manner and to establish short-term and long-term goals and objectives for implementing constructive recommendations. The positive response that we had from a large cross section of very knowledgeable people who are involved in workplace design was very reassuring to our effort. Our only regret was that of the invited representatives of organized labor, none were able to attend. Subsequent meetings and conferences of scientists and industry followed.

We are now moving ahead together with the related sciences in a positive manner to establish agreed upon guidelines for human factors in the office and we are establishing objectives for implementing constructive recommendations. To us, health and safety, as it relates to products used in the office environment, is a natural continuation of our past efforts. The safety and performance standards that BIFMA has generated to date are voluntary standards, not federal or state regulations. Regulation threatens the support for our voluntary programs. Self-regulation is the preferred method in the United States, and is certainly the ally of innovation. The rec-

ommendations that we are preparing are not so narrow that they become design limiting or, on the other hand, so broad that they accomplish nothing.

We, and many of our associates in the interior design profession, know how to design for the total environment. When a careful analysis of the total environment occurs and a human factored plan for the transition is followed, the workers are more comfortable and efficient--which is really the reason for the change in the first place. The basic nature of furniture design is to provide support for the human that makes it easier, more satisfying, and less tiring to perform a task. This is the basic definition of ergonomics. The word which has been used in the furniture industry for years, has now become common to the vocabulary of many. The main difference today is that ergonomic office furniture is now being called upon to integrate with new electronic companions, and for the good of the office worker we want to make sure that within the scope of design and manufacturing, that this takes place in the best possible way.

One avenue open to the furniture industry to participate in the development of a manageable set of proper guidelines is the American National Standards Institute (ANSI) under the auspices of the International Standards Organization (ISO). These guidelines would be developed with the participation of the Human Factors Society, well respected for their work in ergonomics.

Many of the proposed legislative or regulatory solutions recommend furniture that is "adjustable." We certainly agree. However, in the regulatory context, "adjustability" is far too vague and too arbitrary to be regulated. How adjustable? How much adjustability? Must each chair then be measured against the occupant? Science does not support precise answers, but emphasizes a range of approaches or factors. If regulated, many unnecessary questions will be debated without any possible conclusion. For example, what is comfort? One of the major lessons of ergonomics is that all people are different, their tasks differ, and their work environment differs. Ergonomic science cannot, by its very nature, give any absolute limits or figures as to where comfort ends and discomfort starts. There are no absolutes. A subjectivity analysis of comfort does not produce the same results for all people. Precise rules and prescriptions are not called for and may be misleading from a scientific point of view. Such rules do not allow for the range of equipment and interior design solutions which are available in the marketplace, and which are quite adequate to provide for improvements in the work place environment. It would be a mistake to impose any regulation that would completely change the self-regulatory perspective for positively approaching this issue. We already produce the tools necessary to improve the office. We should be allowed to incorporate all the available knowledge into our product's performance and not be stifled with design criteria. A simple regulation to guide the development and design of all VDT work stations is not reasonable.

Furniture for the electronic environment is the fastest growing segment of our industry. The most frequently purchased furniture has been ergonomically designed adjustable tables and chairs.

However well intentioned, there is a counter trend to our efforts that would impose design criteria on our products. For example, there is a movement to regulate that a chair should have a two-part seat and back. Once you regulate this sort of design specification, all the potentially superior qualities that a single contoured seat and back construction offers are voided. Also, along the way, we may lose critical safety characteristics in exchange for increased adjustability. We are prepared to continue to develop a logical approach toward producing the most beneficial products. We welcome the increased focus on the office. We think it is the primary productivity center of the future with enormous economic and personal gratification potential. It has been a good example of how improvements to the workplace can occur without regulation.

One of the real problems in the workplace is not that the right furniture is not out there, it is that management and people who employ workers have not given enough time, up to this point, to the education of how to use that type of furniture. They have also, in my opinion, not given enough attention to ensuring that each of the workers is provided with the correct furniture.

Some recommendations that if implemented right now, would provide immediate improvement in work station usage:

1. Specifications for equipment be based on careful analysis of the task to be performed which will determine the appropriate relationship between the worker and the furniture to be purchased.

2. Training to provide workers with the understanding that the chair and work station can be suited to them by means of adjustment controls.

7. DR. ABERNETHY AND DR. WEISS, ON BEHALF OF THE AMERICAN ELECTRONICS ASSOCIATION

The area of health and safety concerns splits into two parts: first, safety concerns about emissions, that is, what might be coming out of the equipment; and second, concerns about possible health effects of terminal operation.

When we talk about emissions, there are two types, both ionizing and non-ionizing.

The amount of ionizing radiation or energy given off by VDTs is indistinguishable from the background radiation we normally encounter in our day-to-day lives. Extensive testing of VDTs for ionizing and non-ionizing radiation has been done over the past several years by a number of government agencies, including private scientists in the United States and several other countries, including Canada, England, Italy, West Germany, France, et cetera.

The results of all of these tests have been summarized in a NIOSH research report, ". . . that exposure to X-ray, radio-frequency, ultraviolet, and visible radiation was well below current occupational exposure standards, and, in many cases, below the detection capability of the survey instruments used."

The other kind of radiation is called non-ionizing, namely the balance of the electromagnetic spectrum, including ultraviolet, infrared, microwave, radio frequency. Such non-ionizing emissions occur naturally and they are encountered during such things as

lightning storms or from the sun. It also occurs from such man-made devices as radios, televisions, radars, microwave ovens, and other home applicances.

Ultraviolet and infrared have been measured compared to some other sources of radiation. VDTs present a much lower risk. Fluorescent lamps, for example, emit more visible and ultraviolet light. Space heaters give off more infrared radiation with no ill effects.

In the microwave band, VDTs have no components that can generate microwave radiation, and none have ever been detected. In the radio frequency band, the maximum exposure to the operator is more than 10 times less than the limit. The maximum exposure to the operator's hands is well within that limit.

VDTs must comply with the FCC radio frequency emission standard, which was designed to protect exceedingly sensitive instruments from man made electromagnetic interference. This emission standard is more stringent than the exposure standard set for health and safety purposes.

There have been anecdotal allegations that VDT use is associated with birth defects and miscarriages. These allegations have been studied by government agencies which have been unable to make any connection to VDT use.

On the issue of cataracts, the Committee on Vision of the National Research Council, states:

> We find no scientifically valid evidence that occupational use of VDTs is associated with increased risk of ocular diseases or abnormalities, including cataracts.

Specifically, the Connecticut Academy of Science in their study concluded from their review of current literature that the radiation levels required to induce a cataract exceed 10,000 times that possible from a VDT.

The National Academy of Sciences has concluded:

> Ten anecdotal reported cases of cataracts among VDT workers do not suggest an unusual pattern attributable to VDT work: Six of the cases appear to be common, minor opacities not interfering with vision, and each of the remaining four cases had known, pre-existing pathology as exposure to cataractogenic agents.

The U.S. National Institute of Occupational Safety and Health has surveyed some 379 workers at the Baltimore Sun and reports:

> We did not find any significant association between VDT use (including hours per week of VDT operation and total years of VDT operating experience) and the prevalence of eye abnormalities, including cataracts.

Finally, the National Academy of Sciences-National Research Council Committee on Vision concludes that:

> We find no scientifically valid evidence that the use of VDTs per se causes harm, in the sense of anatomical or physiological damage, to the visual system.

There have been a number of survey results indicating that there are temporary headaches, eye aches, back aches, wrist and arm aches associated with improper VDT installation and use.

These complaints can be divided into two categories, based on the fact that the underlying physiological mechanisms are not unique to computer terminals. One area is visual. For instance, reflections from a computer terminal screen can interfere with viewing the screen. Another area is postural, so that the screen can be the wrong height for the physical stature of the person or the person

may sit in an odd position to try and avoid reflections coming from the screen.

With respect to PCB, it was used in some small components prior to 1978. After 1978 they are not used in VDT terminals. To get exposed, you would have to cut or break the component. The amount of PCB in the component is not enough to be concerned about.

We are not talking about the kind of power filters, transformers, that the power company puts on a telephone pole with a liquid PCB bath in there.

As far as radiation is concerned, there is nothing you can do to the VDT which could enhance or change the operating conditions with respect to radiation emissions. So from that point of view, even if it is not maintained properly, the effect on the health of the individual would be zero.

Obviously, if it is not maintained properly its use would not be as good as it was before, so therefore this would essentially stimulate the user to get it repaired. But we have looked at a large number of defective units and we don't find any impact on the health and safety of individuals.

The unnoticed "leakage" concern is a holdover from the television industry circuits of the late 1960's. In particular, the National Research Council of the National Academy of Science observed that:

> In 1967 national attention was drawn to the emission of x radiation from color television receivers. Some color televisions and some VDTs in use at that time used a high voltage shunt regulator, that emitted higher than acceptable levels of x radiation leakage. Solid-state circuitry has now eliminated the use of shunt regulator tubes in color televisions and VDTs, and only the cathode-ray tube (CRT) remains as a potential source of x radiation, as noted above, the face of the CRT is shielded to prevent unacceptable levels of x radiation from passing outward.

All modern televisions and computer monitors use solid-state circuitry which cannot operate in the manner these older televisions did.

The only vacuum tube left in modern units is the cathode-ray tube itself. This tube is constructed of sealed, lead impregnated glass. The lead in no way shifts, wears or evaporates because it is an integral part of the glass. Should the glass suffer a slight airleak, the oxygen in the air upon entering the tube would interrupt operations and cause the filament to oxidize quickly, rendering the unit useless.

The conclusion regarding ELF and VLF is that no scientific evidence exists, to date, directly connecting ELF or VLF emissions from VDTs to harmful biological effects.

There is a controversy arising in Canada between a theoretical position of H.D. Sharma of REMS in conjunction with the Canadian Centre for Occupational Health and Safety and an experimental fact-finding position of S.M. Harvey of Ontario Hydro Electric.

The theoretical position is that for all electrical and electronic equipment the emission least known about is VLF and ELF; therefore, if any culprits exist for VDTs, they must be it. The experimental position is that the existing measures, studies and standards for ELF and VLF cannot implicate VDTs, and Ontario Hydro is pursuing a study to resolve the controversy.

We, as an industry, see no health and safety issue. We do see a comfort issue. We do see a public information issue. And we seek to try and communicate this to the public, to the managers, as well as producing the products.

It is our perception that the proper approach to the issue of providing workers who use VDTs a safe and comfortable work station can best be accomplished by accommodating to the individual needs of the VDT user as developed by management and the users, not by mandatory government regulations and standards.

8. DR. BOND, ON BEHALF OF THE AMERICAN COLLEGE OF OBSTETRICIANS AND GYNECOLOGISTS

When reviewing the incidents of spontaneous abortion and congenital malformations among VDT operators, it must be remembered that the rate of spontaneous abortion for all pregnancies ranges from 10 to 20 percent. Although the major cause of miscarriage in the first trimester is unknown, chromosomal abnormalities have been shown to be associated with the majority of these pregnancies. Congenital malformations occur in approximately 2 to 4 percent of all live births.

Based on the scientific evidence to date, the American College of Obstetricians and Gynecologists concludes that radiation emitted from video display terminals is insufficient to cause spontaneous abortions, birth defects, or any other adverse effect on reproductive function.

In January of this year, the American Medical Association released a report on physical forces in the workplace which stated that "several careful and thorough studies by both private and governmental experts have concluded that there is inadequate electromagnetic radiation at any frequency (X-rays, ultraviolet, visible, infrared, microwave, and radiofrequency) to cause adverse biologic effects." In October 1983, the American Council on Science and Health issued a press release which concluded that "computer terminals, word processors and similar devices do not pose a radiation hazard . . . they have not been shown to cause cataracts, permanent damage to vision, miscarriages, or birth defects." Dr. Arthur Salisbury of the March of Dimes stated in June of last year that, "there is no evidence to indicate that VDTs emit radiation that can cause miscarriage or birth defects." Last month's issue of the "FDA Drug Bulletin," distributed to physicians and other health care professionals, stated that there is no evidence that radiation emitted from VDTs causes adverse pregnancy outcomes. The report also noted that the reports of "clusters" are probably due to chance because of the large number of pregnant women working with VDTs.

There appears to be no specificity in the birth defects reported in the "clusters". In general, specificity of birth defects would be expected if they were due to a single cause, such as radiation. It is not known what other factors, i.e., genetic predisposition, stress, smoking, or alcohol intake, may have contributed to the rate of miscarriages or birth defects among users of VDTs.

Epidemiological studies to determine adverse effects of VDTs are extremely difficult to carry out because of the difficulties in obtaining control groups, the need for a large population to determine

statistical significance, confounding variables, and the subjective nature of responses to questionnaires which have provided the major source of data from VDT operators.

I don't think it would be practical to s udy every workplace. I question whether that would be a reasonable use of resources.

Pregnant women who work on video display terminals should be allowed to continue to do so as long as it is physically comfortable. According to the ACOG "Guidelines in Pregnancy and Work", the "normal woman with an uncomplicated pregnancy and a normal fetus in a job that presents no greater potential hazards than those encountered in normal daily life in the community may continue to work without interruption until the onset of labor and may resume working several weeks after an uncomplicated delivery."

Current scientific literature indicates that the level of radiation emitted from VDTs is insufficient to cause spontaneous abortions or birth defects. Emphasis should be placed on ergonomic factors, which can be changed, to ensure a safe and pleasant working environment.

9. DR. RICH, DR. SOMMER, AND DR. MAINSTER, ON BEHALF OF THE AMERICAN ACADEMY OF OPHTHALMOLOGY

The Academy has concluded, based upon existing scientific evidence, that video display terminals or units (VDTs, VDUs) are safe for normal use and present no hazard to vision. It is not our intention to minimize or ignore the numerous complaints of visual discomfort, blurred vision, headaches, backaches, and muscular pain which many workers association with heavy VDT use. However, it is the Academy's scientific and medical conclusion, based upon available scientific studies, that these complaints of physical discomfort and transitory symptoms must be distinguished from permanent medical disorders or refractive errors.

There is no clinical or experimental evidence that ocular fatigue experienced by some VDT users can cause any pathologic change. Such fatigue and other complaints may be lessened or relieved by appropriate actions within the workplace. Such actions may include the use of stable higher-resolution VDT screens; arrangement of work stations and/or lighting to reduce glare; adjusting screen contrast and orientation; and changing keyboard position to individual preference and comfort; or alternating periods of heavy VDT use with other tasks that allow the employee to move about.

The Academy does not at this time believe that available scientific evidence warrants annual ophthalmologic or optometric eye examinations purely on the basis that a worker regularly uses a VDT. While there are individuals with conditions that may warrant annual or even more frequent medical or refractive eye examinations, such as those experiencing rapid progression of myopia, the Academy has found no evidence to date that any pathologic eye condition can be worsened or accelerated by VDT use or that a normal eye can be damaged by use of VDTs. There is little doubt that VDT use is a demanding visual task, just as reading of printed materials is a demanding visual task, and that heavy VDT use can be stressful to the eyes, just as prolonged reading or typing can be stressful. Under such conditions, an individual may first

notice a refractive error that can be corrected by appropriate lenses, and such an individual should be encouraged to seek appropriate correction. But nothing in the nature of VDTs or VDT work suggests to the Academy that annual eye examinations are appropriate or needed for all VDT users

A number of studies have been made by scientists at the Bureau of Radiological Health (BRH), Bell Laboratories, and NIOSH. The data from their work indicates that the VDTs "emit little or no harmful ionizing (e.g., X-rays), or non-ionizing (e.g., ultraviolet (UV)) radiation under normal operating conditions." The emissions that were detectable were all well below the current national and international safety standards.

As for ocular damage, the best available current experimental and epidemiologic evidence does not indicate (or demonstrate) that the level of UV radiation emitted by VDTs is capable of exerting any deleterious effects on the ocular lenses of personnel using these terminals. Further, our own lens serves as a natural filter for UV radiation that is directed toward the eye, thereby protecting it and the retina, which is sensitive to low-level UV radiation.

When people are not ordinarily working at a very close distance and they begin to do so, they may discover they are getting headaches or they are getting "eye strain", feeling discomfort after prolonged reading at close distances. So if an individual is now doing a visually demanding task at close distances which they didn't have before, they may discover that they need to use reading glasses.

Alternatively, somebody who already has reading glasses and has those reading glasses set for a specific distance, up close where they usually were, now by using the VDT are working at a slightly farther away distance and those glasses aren't set for that distance, they may find they have to change the prescription in those glasses.

Furthermore, the bifocal nature allows you to read when looking down the way they are ordinarily made. A person at a VDT very often is looking up while they are reading and they have to have their glasses changed.

10. DR. MILLAR, DR. LANDRIGAN, AND DR. JOHNSON, ON BEHALF OF NIOSH

As VDT technology has emerged NIOSH has focused on the possible impact of video display terminals on the health of the workers using them.

In general, our investigations suggest that the VDT revolution in the workplace has produced impressively few problems considering the scope of the technologic change. To be sure, we have identified some problems associated with the use of VDTs, but the evidence to date indicates that these are relatively minor, and will not retard the rapid increase in use of this technology.

Nonetheless, the perception that VDTs are hazardous is widespread, and will no doubt continue. We expect to be responding to such concerns for a long time.

To date the concerns about VDTs and their possible implications for health have focused on three areas:

1. Is the VDT a source of dangerous radiation?

2. Does the VDT increase psychological stress and musculoskeletal strain on workers using it?

3. Does the VDT affect reproductive function?

The evidence we have so far, though incomplete, permits us to respond to these questions.

1. We do not find VDTs to be a source of dangerous radiation.

2. Yes, there is some evidence that VDTs can increase both physical and emotional stress in workers, our studies also suggest measures by which these stresses can be prevented.

3. Although we do not see any physiologic mechanism whereby VDTs could impair reproductive function, as yet we do not have the information to definitively rule out an effect of VDTs on reproduction. Therefore, we have begun to plan a major epidemiologic study designed to definitively answer the question.

The study will be a three-year follow-up study which starts with the population on approximately 6,000 women employed in offices, half of them working with VDTs, half of them not.

What we say from our observations is there is not a risk of dangerous radiation which can be looked at as a cause of birth defects, but I think that the fact that so many people have anxieties about this requires that as a responsive public health agency, we try to resolve this issue and provide a definitive answer, and unfortunately, a definitive answer cannot be provided from the study of individual clusters.

There is no occupational exposure standard specifically for VDTs. However, all measurements of radiation emissions from VDTs are far below the present national occupational exposure guidelines and standards for radiation. The ultraviolet, visible, and infrared emissions are less than 1/100th of the allowable level in the applicable standard; the RF radiation and x-ray levels are less than 1/10th of the allowable limits. Although no national standard has been established for extremely low frequency (ELF) radiation, measured levels from VDTs have been found to be less than those emitted by hair dryers, irons, and other typical household appliances. All forms of radiation measured were at levels well below those documented in the scientific literature as necessary for causing adverse biological effects. This data indicates that the radiation shielding that is already an integral part of the VDT equipment is adequate in protecting the worker against the radiation produced by the machine.

NIOSH has conducted questionnaire surveys in particular workplaces to determine the range and nature of health complaints potentially linked to VDT use. In these surveys, VDT work stations were also evaluated for ergonomic problems, those associated with the interaction of man with machine. In some cases, radiation emissions were also measured. Results indicate that VDT operators report frequent visual and musculoskeletal strains and discomfort. The visual complaints are most frequently eye fatigue, eye irritation, and blurred vision. The musculoskeletal complaints are pain or stiffness in the neck, shoulders, back, arms, wrists and hands. These effects are most prominent among workers who: (a) engage in repetitive VDT work with little opportunity for variation, (b) spend long, uninterrupted periods at the VDT, and (c) undertake

VDT work requiring intense, visual concentration. Operator complaints most often relate of glare, poor illumination, and work stations shown by ergonomic evaluations to be ill-suited for VDT viewing.

There have been few clinical examinations of VDT workers to establish the presence of functional losses in vision or evidence of other effects to the body. In a 1980 clinical study by NIOSH at a newspaper publishing operation, we did not find an association between VDT use and the prevalence of visual pathology, including cataracts. However, reported musculoskeletal problems, headaches, changes in visual function, and various other symptoms were especially prevalent in operators using VDTs on which screens were improperly positioned or screen glare was present.

Questionnaire data indicate higher levels of psychological stress in VDT operators than in workers engaged in similar tasks but not using VDTs. This may result from the VDT operator's perception of greater work pressures; loss of autonomy; involvement in fractionated, simplistic tasks; and their concerns about job security. Because work situations differ widely, it is difficult to make universally applicable recommendations on VDT use.

Long-term studies to evaluate possible chronic effects of VDT exposure on vision have not yet been done, thus questions about the cumulative effects of visual strain due to video viewing remain unanswered. NIOSH is currently pursuing the possibility of such a long-term study.

Three studies by NIOSH contrasting good and poor conditions of glare control, work station adjustability, seating and work/rest regimens were designed to determine the effects of these conditions in simulated VDT operations. The findings underscored the importance of glare control, certain work station dimensions, chair adjustability and back support, and rest breaks in easing operator discomfort. Improving ergonomic conditions reduced visual and musculoskeletal complaints and increased work efficiency.

We are aware of reports that have appeared in the news media of 10 clusters of adverse pregnancy outcomes among VDT users. In each cluster, a small group of women experienced several adverse pregnancy outcomes.

Although it is possible such clusters may reflect a relationship with VDT use, it seems likely that they represent a chance occurrence that is statistically predictable.

As a whole, the findings to date suggest that visual and musculoskeletal problems are the most frequent complaints of VDT operators. These problems seem amenable to control by making ergonomic improvements. The stress issues are more complex and are probably influenced by numerous factors in the workplace and not just to the use of VDTs. Whether long-term VDT use causes significant visual dysfunction or degeneration remains unknown and requires further investigation. Based on extensive radiation measurements and reported health data, NIOSH has concluded that VDTs do not present a radiation hazard to the VDT operator or to the developing fetus. No scientific evidence exists that the reported clusters of miscarriages and birth defects are associated with radiation exposure from VDTs. However, because alleged clusters of adverse reproductive health effects continue to be reported, further

research into the possible link between VDT use and adverse reproductive outcomes is warranted.

Recognizing the state of knowledge regarding ergonomic, stress and radiation issues in VDT work, NIOSH recommends the following general guidelines, which may require modification in specific situations:

(1) Workstation design: Maximum flexibility should be designed into VDT units, supporting tables, and operator chairs. VDTs should have detachable keyboards, work tables should be height adjustable, and chairs should be height adjustable and provide proper back support.

(2) Illumination: Sources of glare should be controlled through VDT placement (i.e., parrallel to windows as well as parallel and between lights), proper lighting, and the use of glare control devices on the VDT screen surface. Illumination levels should be lower for VDT tasks requiring screen-intensive work and increased as the need to use hard copy increases. In some cases, hard copy material may require local lighting in addition to the normal office lighting.

(3) Work regimens: Continuous work with VDTs should be interrupted periodically by rest break or other work activities that do not produce visual fatigue or muscular tension. As a minimum, a break should be taken after 2 hours of continuous VDT work and breaks should be more frequent as visual, mental and muscular burdens increase.

(4) Vision testing: VDT workers should have visual testing before beginning VDT work and periodically thereafter to ensure that they have adequately corrected vision to handle such work.

Our general reaction to the National Research Council study entitled "Video Displays, Work and Vision," was that it was the best available compendium of all information to date on the issue of VDT use and its ramifications for health.

We criticized it in one rather narrow dimension, that was, it seemed to underemphasize, in our judgment, the need for continuing research. We saw the VDT matter as the most significant technological revolution in work in a long time, and we felt that surely a strong plea should be made for extensive and continuing research on aspects related to health. But other than that, we didn't have major problems with the report.

11. DR. BROWN, MR. CASHAU, AND MR. NEERGAARD, ON BEHALF OF THE AMERICAN NEWSPAPER PUBLISHERS ASSOCIATION

The newspaper industry has long been a major user of VDTs. First introduced into the newspaper industry in the early 1970's, VDTs have revolutionized production of the American newspaper, serving as powerful editorial tools for journalists. VDTs have also been responsible for greater efficiencies in the production of advertising and page layout. Currently, there are more than 50,000 VDTs being used in newspapers throughout this country. While VDTs are generally concentrated in the newsroom and classified advertising departments, they are also found in display advertising,

the mailroom, the composing room and b ess offices of the newspapers.

Since the early 1970's, the American Newspaper Publishers Association has provided assistance to its members on use of the VDT in the workplace. We conduct technical research and provide assistance to our members in all aspects of the production of newspapers. ANPA has collected and reviewed the scientific literature on VDTs, and has provided it to its members. ANPA staff experts have visited newsrooms and explained how a VDT works and answered employee questions. In 1974, the Association established an ANPA Environmental Committee to provide greater assistance to members on various workplace environment issues including VDTs.

As Medical Director of The Times (Dr. Brown) for the past nine years, I have responsibility for the health of its 4,400 employees. In this capacity, I have carefully studied the scientific literature developed on VDTs. I am also active in a number of medical societies and associations. From my review of the literature and my experience at The Times, I can unequivocally state that I am aware of no medical evidence which demonstrates serious health effects from VDT usage.

In 1977, NIOSH was called into The New York Times to investigate the allegation that four employees had developed cataracts while working on VDTs. NIOSH found that one of the four did not have cataracts upon examination by an ophthalmologist and another never worked on VDTs. The other two had cataracts but the NIOSH investigation failed to find VDTs to be the cause.

The Newspaper Guild then sued The Times in the United States District Court, Southern District of New York to prohibit the assignment of these employees to VDT terminals. The case was referred to arbitration and the arbitrator, after careful consideration of the evidence, employing the resources of an outside engineering firm and three ophthalmologists, determined that VDT usage was not the cause of these employees' cataracts.

NIOSH also conducted health and hazard evaluations at the San Francisco Newspaper Agency and The Oakland Tribune in 1979-80 and found no serious health effects among the users. In the San Francisco study, NIOSH used a questionnaire to assess health complaints and psychological moods of VDT operators. This was not a controlled field study, and traditional sampling strategies and survey distribution methods were not used. The results of the self-administered questionnaire indicated that VDT operators reported higher levels for a limited number of visual and musculoskeletal complaints than non-VDT operators. However, NIOSH qualified the reliability of such a finding, noting the non-compliance with strict survey research procedures as well as the fact that difficult labor negotiations were under way at that time.

In October 1983, Dr. Arthur Frank, on behalf of the Newspaper Guild, submitted to the Subcommittee a "purported" scientific study of VDT operators in the newspaper industry.

I have carefully reviewed Dr. Frank's study and have several observations to make. First, I am unaware of any "peer review" of Dr. Frank's study, as is usually the case in any scientific study. Perhaps, the Frank Study might be submitted to the National Re-

search Council which completed an extensive review of the VDT literature in 1983. Second, the scientific nature of this study is open to serious question since it was based on anecdotal evidence derived from a questionnaire. Third, Dr. Frank himself acknowledges that there were "methodological problems" with the study and "aspects about it which are open to valid critique." There is clearly inadequate data furnished in the study. For example, the questionnaire which was compiled was not furnished with the study results. Given the absence of peer review, and the problems inherent in the methodology employed, the study is of limited use.

The Medical Society of the State of New York, which represents 25,000 physicians in New York State, passed a resolution in October of 1983, opposing VDT legislation pending in the New York legislature. In this resolution, the Society urged that accurate information be provided to employers and users about VDTs.

In looking at VDT ergonomics, the following factors are usually considered: glare, illumination, furniture and room design, and brightness and contrast contols.

Dr. Martin Helander has reviewed the varied and oftern contradictory European VDT standards. One German standard suggests positive images on the VDT screen. In contrast, an English trade union standard advocates negative images.

Under the German DIN standard, the preferred color of the display images is green through orange. The Technical University of Berlin suggests yellow-green. The Canadian Defense and Civil Institute of Environmental Medicine standard provides that only green or white display images should be allowed.

Illumination varies from low to very bright from country to country. The recommended lux range for VDTs goes all the way from 200 to 1076.

Each individual user should be able to adjust his or her VDT. This adjustment capability should include brightness and contrast controls as well as viewing angle, height, etc. We urge our members to buy VDTs with a full range of operator controls.

There are no clearly defined ergonomic standards. By cavalierly embracing one standard over another in a regulation, we would be retarding the progress which continues to be made in the design of work stations, including keyboards, screens, furniture and lighting. The suppliers of this equipment—because of user pressure—are constantly improving their product. The natural forces of the workplace will penalize a manufacturer selling ergonomically inferior VDTs and furniture, and reward the manufacturer who produces a quality product.

Most of the concerns of our newspapers and their employees about radiation are resolved through provision of information and throughout sitting down and talking with the employees. However, if necessary, we will visit a newspaper and test the VDTs. We have tested approximately 1,000 VDTs, and we have never found a radiation emission which even approached the federal standard.

A video display terminal contains a cathode ray tube (CRT) which is a specially-designed, big vacuum tube. The inside, front surface of the CRT is coated with a phosphor material (anode) which gives off light when struck by electrons which are propelled toward it by an electron gun (cathode). The phosphor material de-

termines the color of the images seen by the operator. Visible images are produced in the VDT when the electrons strike this phosphor coating inside the tube.

Some of these electrons can cause low energy X-rays. However, these X-rays are shielded from escaping the tube by the thickness of the glass, which is a very effective barrier. Radiation measurements taken on the outside surface do not register any ionizing radiation except background.

As for non-ionizing radiation, in our test we measure for visible light, infrared, radio frequency, ultraviolet A (UVA), and ultraviolet B (UVB). We have yet to find any radiation which approached existing standards.

Various questions have arisen about whether the VDT can malfunction and can emit radiation. This does not occur because a VDT will fail if there is a power surge.

(Mr. Neergaard conducted a demonstration of the testing procedure used to determine if a VDT emits radiation. He measured for ultraviolet, infrared, radio-frequency and ionizing radiation. The various instruments used to make the test measured the existing radiation in the atmosphere of the hearing room, but there was no discernible increase in radiation found when the VDT was checked directly by the instruments.)

12. MR. ROMANO AND MR. KILLMON, ON BEHALF OF THE PRINTING INDUSTRIES OF AMERICA

The first VDTs were installed for typesetting applications in 1968–1969 by Hendrix Electronics (for Associated Press) and Harris Corp. (for United Press Int'l.). At present there are an estimated 267,000 VDTs in use specifically for typesetting input, editing and page assembly. These units are installed in 64,361 sites in the United States—an average of 4.2 VDTs per site.

The 64,316 sites include commercial printing firms, book and magazine publishers, typesetting services, newspapers, both daily and weekly, and corporate (inplant) printing departments; 64% of these sites, or 41,200 firms, have less than 20 employees.

There is no current evidence showing that use of VDTs causes chronic visual disease, or that the vision of VDT operators deteriorates faster than the vision of workers in other jobs. This may reflect a lack of knowledge about long-term effects from VDT use. While there appears to be no cause for alarm, concern is justified, and further research into the influence of VDT viewing is needed.

There is conflicting evidence concerning the relationship between the VDT work and the use of corrective eye wear.

We are an industry where the majority of users are small businesses and cannot readily change equipment; but we also have over half of the equipment installed prior to 1980, and thus approaching a replacement point.

Because of this situation we fear the impact of legislation that would impose stringent "ergonomic" requirements (adjustability of keyboards and screens, for instance) on the installed base of "older" equipment.

Since all existing studies indicate that there is no radiation danger, and since firms will replace the bulk of installed equip-

ment over the next 4-5 years in any case, workers will phase into newer devices within a reasonable period and within a safe environment.

There is a growing body of research on VDT use. VDTs in use in word processing, data processing, telecommunications, and personal computing number in the millions. We support government monitoring and recommendations on their use in the workplace, but these recommendations should be weighed against current and future methods of VDT use in various industries. Many industries make unique use of such devices which will determine their health impact on users.

13. MR. HENRIQUES, ON BEHALF OF THE COMPUTER AND BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION

The Computer and Business Equipment Manufacturers Association represents 42 of the largest computer and business equipment manufacturers in the United States. Our members not only make visual displays—they also buy them to incorporate into more sophisticated equipment. Our member companies use visual displays. They have probably the longest experience of any business in the use of visual displays in the laboratory and in the workplace.

We found from the very start that visual displays emit no harmful radiation—that they are completely safe to operate. In fact, they are among the safest devices used in the workplace today. Radiation emissions from the equipment are so far below occupational health and safety standards as to be almost non-existent. Radiation is far below the background level, and is comparable to the radiation coming at us from walls, from lightbulbs or from other people's bodies.

If the set is not in perfect condition, it won't operate and there is no radiation at all. If there were a voltage surge or something were to go wrong with the VDT, it would not operate. If the cathode ray tube, the big TV-like tube, in the machine misfunctions, then nothing happens. The circuits go—the amount of voltage used in the circuits is so low that, if one of those blows, nothing works and you get no radiation, not even light. If there were a leak in the tube, there would be no radiation because it doesn't work. The nature of a cathode ray tube is such that it is sealed.

Some people have commented that what if you had a sudden pulse, an overcharge, excess voltage applied to the unit. The first thing that would happen is, in the first half a millisecond, certain circuits in the machine would melt and nothing would function.

Many people today are seeking workplaces that are not simply safe but that are also comfortable, mentally stimulating but at the same time free from unnecessary stress. These needs are fully compatible with the introduction to computers. But some users and managers do not understand that new equipment may create new dimensions to the quality of worklife question:

> If work and therefore jobs have been restructured as a result of new equipment, then users need to understand where their new career paths lie.
>
> If paper systems have been replaced by electronic information, then the office probably needs physical modification.

The lights from the old office may be too bright.

The noise level may now be so low that people need a "white noise" system to protect their privacy.

Sunlight through the windows may be creating glare on screens, making characters hard to read.

People who've been avoiding glasses by holding paper closer to their eyes now discover that, since they can't move the terminal, they need to give into reality and get a prescription.

And, freed from the need to file and carry messages into offices, users may now be moving around so little that they need to take breaks specifically to get some exercise.

These problems and questions are easily corrected. But some of today's users and managers aren't fully aware of the problems. They may believe that visual displays cause backaches even though the real problem is that they're not getting enough exercise. They may not be fully aware that reading at a new focal length causes some eye deficiencies to become more obvious; instead they think that visual displays cause headaches.

Because of the lack of awareness of both the problems and their solutions, some individuals and organizations are advocating legislation. In fact, in the past two years, fifteen states have considered bills or regulations that would impose all kinds of restrictions on the use of visual displays that would:

Force people to sit in special chairs, even if they were satisfied and comfortable in the present model.

Mandate covering windows with blinds even if their were no glare problem, or even if the glare problem came from another source.

Force low light levels in all workplaces using visual displays, even though such light levels might pose serious problems—such as on a factory assembly line—or might even be dangerous—as in a hospital.

Reduce the number of hours people could work on displays to a maximum of four or five, evidently ignoring the fact that millions of users would be forced out of full-time jobs and into half-time jobs, reducing their pay and removing many fringes.

Force employers to pay for meaningless devices and activities such as metal shielding for terminals and radiation inspections. Channeling funds into useless items simply raises the cost of products, making companies less competitive with others around the world.

Let me cite some of the ways we are trying to educate people about the best use of visual displays in the workplace:

Most companies are now packing literature in with new displays telling users about the safety of the equipment and giving them advice on the best way to use it comfortably.

Our industry is working on radio and television public service announcements to inform people about safety and comfort issues.

We are also developing an educational campaign. Our half-day training program will cover both safety and comfort aspects of visual displays. It will also cover issues like job design and the positive introduction of technological change.

We are working with various industry associations to develop training programs specific to those industries. And we are working with professional trainers from the American Society for Personnel Administration to offer the program regionally.

These training efforts will escalate throughout next year. We feel strongly that offering practical advice to both managers and users will greatly alleviate the concerns of visual display users.

Another aspect of our nationwide educational program is the development of a video news clip, to be distributed to TV stations throughout the United States. Aimed at the user, this news clip will not only offer practical advice about using display equipment comfortably, it also will alert users to the fact that they can solve most of the problems they face simply by applying common sense techniques to the challenges of technological change.

We will also be reaching the pbulic through print. We have developed a series of question and answer columns that will start appearing in newspapers late this summer. The columns ask common questions about working with computers and provide down-to-earth, easy-to-understand solutions to problems that arise.

We continue, of course, to distribute recommendations on using visual displays and synopses of scientific information about safety and comfort issues.

We have also developed a videotape featuring prominent scientists who discuss the health and safety aspects of visual displays. They explain clearly and concisely that there is no health and safety danger, that there is no need to hold any fears about birth defects or cataracts resulting from the use of the machines.

There is no connection epidemiologically that can be demonstrated for any of the specific physical problems that have been cited, such as birth abnormalities or eye problems. While there are comfort problems, while there are muscular and skeletal discomfort problems associated with this kind of work, those are easily solvable. There is simply a matter of recognition that this is a different kind of work than everyone else has done before and there are certain things that have to be done to take care of that, and they are very simple things, such as getting up and moving around and making sure you blink your eyes, making sure the lighting is correct. It is breaking the habits and cultural patterns of 50 years in America. Most of our offices are too brightly lighted anyway. Most of the furniture that was bought for the last 20 years, immediately after World War II, was modern, teak, chrome and very dysfunctional.

14. STATEMENT OF THE AIR TRANSPORT ASSOCIATION

It is estimated that airlines utilize more than 100,000 VDTs at the present time and more than 23,000 airline appointed travel agents use thousands of additional VDTs to serve the public expeditiously and economically.

Today, nearly every facet of airline activities—almost anything an airlines does from marketing to maintenance to flight operations—utilizes video display technology. It is estimated that approximately half of the industry's more than 300,000 employees use video display equipment.

Airline managements have been responsive to employee concerns that have arisen as a result of the rapid evolution of automation and video display equipment and the industry has made necessary improvements in the work environment as technology made them feasible. As a matter of highest priority, the airlines have established work practices and taken whatever actions are necessary to assure the safety, health and comfort of employees.

The following illustrates some of the airline practices used by individual ATA member carriers to address the full range of work environment issues, relating to the operation of video display terminals:

The airlines employ full time corporate safety and health specialists who, along with outside consultants, are utilized to address VDT-related problems or concerns such as screen glare, keyboard adjustment, ergonomic matters and environmental considerations.

Airlines are continually improving facilities and work station designs and upgrading equipment to state-of-the-art.

Employee involvement committees or councils provide a forum for mutual exchange of views, suggestions and feedback between the employer and employees. This practice often has resulted in workplace improvements.

Programs have been implemented by the airlines to provide employees with counseling, information and educational materials related to the use of VDT equipment.

The airlines are developing educational campaigns and specific training programs covering the safety and comfort aspects of video display equipment.

The airlines are working jointly with governmental, manufacturing and user groups to develop educational information and practical management principles to address matters related to video display equipment.

With regard to various areas of specific concern that have been raised, we respectfully submit the following views:

Radiation.—Numerous scientific studies have been undertaken on this subject; independent authorities have investigated potential radiation hazards associated with VDT usage and have repeatedly concluded that there is no evidence of health hazard. These determinations include pregnancy related claims as well as other health concerns. Our industry welcomes independent scientific examination of new technology, and it will continue to cooperate in NIOSH investigations of alleged safety problems. However, available scientific data and other findings indicate no need for additional radiation shielding of any sort nor reduced exposure times. It has been shown that radiation levels from VDTs are not more than from other common sources such as television sets, microwave ovens, computer games and some natural terrain.

The Canadian Department of National Health and Welfare has stated, "Radiation emissions from VDTs are either non-existent or

are so low that no standard in the world would classify these emissions as hazardous." A 1984 published study by the Connecticut Academy of Science states, "VDT x-radiation is not of sufficient intensity to cause damage to unborn children, nor is such damage caused by other wavelength " The study further concluded that " . . . numerous ailments and discomforts have been attributed to VDTs) . . . but in no instance is there any reason to believe that emitted radiation is among the causative factors."

Vision.—Eye fatigue is sometimes associated with intense VDT use, as it is with any close task. Medical and scientific reports from respected sources indicate that such fatigue has no implication for eye disease or injury. During 1983, The National Academy of Sciences issued a report that stated categorically that there is no evidence to link eye disease or harmful radiation effects with exposure to video display terminals. Airlines are incorporating up-to-date technology such as glare controls, adjustable chairs, louvered lights and the airlines are making other workplace changes to minimize eye discomfort. Airline employees receive routine 15-minute work breaks and VDT users are able to make frequent excursions from the equipment while carrying out their duties. Annual eye examinations are included in many medical benefits packages available to airline employees regardless of visual task.

Musculoskeletal.—Stationary office jobs have been a part of business for many years, and any musculoskeletal problems reported today among VDT users are not likely to be unique to VDT use. VDT use is not significantly different than typewriting. However, advanced technology has resulted in an evolution of improved furniture design, adjustable keyboards, and numerous other improvements in the airline workplace environment. The airlines use trained ergonomic experts to teach VDT users how to properly adjust chairs and keyboards and tailor their work station in ways that accommodate individual needs. Additionally, educational materials, booklets and other information is made available to teach at-desk exercises and to provide other suggestions to prevent musculoskeletal symptoms.

Stresses.—The airlines are keenly aware of the desirability of minimizing undue job stresses. VDT work is no more stressful than similar kinds of exacting work not involving VDT equipment. The airlines recognize that stress can be related to equipment or job design, working conditions, individual characteristics or other factors. Stress related to job performance monitoring has historically been a part of the employee/employer relationship. Like any management tool, however, performance monitoring must be applied with prudence and used to enhance employee development. We think our industry utilizes responsible standards in this regard. Among the most effective management practices used by the airlines to deal with stress related questions are the various types of worker/manager forums providing opportunities for employees to express views, provide suggestions and explore solutions to deal with stress matters.

The issue is not one of health or safety, it is a matter of employee confort, and our member airlines will continue to develop solutions that are responsive to related questions or concerns on a case-by-case basis. The data and opinions of authorities demonstrate

that there is no need for either regulation or legislation to deal with video display equipment.

15. STATEMENT OF THE AMERICAN FEDERATION OF STATE, COUNTY AND MUNICIPAL EMPLOYEES

The American Federation of State, County and Municipal Employees (AFSCME), represents one million employees in local, state and federal government. Over two hundred thousand of our members are clerical workers or professionals who work in office settings.

We are increasingly concerned about the safety and health effects of VDT equipment and the way in which it is used on our members.

The primary and immediate health concern is the visual and musculoskeletal problems resulting from poor ergonomic design of the VDT equipment and of the work setting. Chronic headaches, eye strain, and fatigue are common complaints among frequent VDT users. Backaches, neck aches, wrist tendonitis and carpal tunnel syndrome can be the result of equipment that is poorly placed in the work area or is not adaptable to differences in users' heights and preferences for viewing distance. Lack of appropriate auxiliary equipment, such as confortable chairs and wrist rests, can also increase physical ailments among frequent users.

The recent report by the National Academy of Sciences entitled *Video Displays, Work and Vision* has been cited in the press as reporting little impact of VDTs on safety and health. We feel that the report was overly narrow in its evaluation. It was too prone to leap from the conclusion that research has been scientifically flawed to the conclusion that long-term health impacts are not a problem. On the other hand, the report also corroborates many of our concerns. For example, it found that ". . . the results of studies indicate that many VDT operators do experience significant discomfort. It is likely that this discomfort is largely caused by inappropriate workstation design."

The Academy panel of experts put the blame for VDT problems where AFSCME has put it, when it noted that ". . . differences in reported symptoms between VDT workers and non-VDT workers might be more directly related to characteristics of the work situation—i.e., the way in which VDT's are used—than to characteristics inherent in VDTs." The equipment itself—and this is true of any technology, not just VDTs—is just one cause of problems, usually the most easily correctable. Other health problems occur because proper equipment, proper maintenance and well-designed work settings are more expensive for employers. Too often, poorly designed equipment is put in traditional offices without appropriate changes in lightning and other equipment. Unfortunately, most employers will not invest in better-designed, more adaptable, but perhaps more costly equipment unless pressured by their workers, by government regulation, or by a noticeable decline in productivity resulting from an extremely bad work situation.

The impact of VDT radiation on operators is a controversial issue. Scientific questions beyond our expertise surround the current standards, methods, and instruments for determining whether

a hazard exists. The debate extends beyond just VDT research and centers on how little is actually known about the effects of long-term exposure to low frequencies of radiation. Research to date has not shown that radiation from VDTs—even poorly maintained ones—is at hazardous levels, but areas for future research remain.

Recommendations

AFSCME sees a federal role in addressing the safety and health issues associated with office automation in several areas.

1. To fund continuing research into the health effect of machine design and workplace design;
2. To establish a central source of information on equipment, for users as well as purchasers, including evaluations according to a set of criteria that address that concerns of users;
3. To set minimum standards based on current and future experience and research, which will reduce chronic health effects and safety problems, for such areas as:
   - character size and clarity;
   - adjustable screen angle;
   - adjustable screen brightness and detachable keyboards;
   - adequate office lighting;
   - standards for maintenance of equipment; and
   - regular eye examinations for VDT operators.

Beyond the immediate health effects of VDTs, AFSCME is also concerned about the effect of VDTs on the kind of work our members perform.

The VDT equipment itself is a relatively small part of the change to office automation. Experience with VDTs suggests that some of the major problems for workers do not result from the machinery itself, but from the way the employer uses the machinery to redesign work. Computerized office equipment can make routine daily tasks more bearable and easier for all white-collar workers. The computer at the heart of the VDT can also be used, however, to measure work output and work performance, using some quantifiable but overly simplistic measure such as "number of keystrokes" per hour.

The ability of a computer to handle many complex tasks in a routine way may be used to give the "thinking" aspect of the job to the machine rather to the person, leading to "deskilling" jobs. Jobs for many workers could center around following set routines that require little training, leading to lower pay, and increased use of part-timers or home-workers who receive few or no benefits.

The redesign of work through office automation has a number of consequences. Intensifying work effort for routine word processing and data entry operators will exacerbate whatever safety and health defects exist in the equipment itself. The increased stress will bring increased levels of anxiety, irritability and depression. Stress is also associated with chronic health problems such as high blood pressure and heart disease and with higher rates of divorce and other family problems. Addressing these problems is not a matter of improving equipment. A comfortble chair, proper lighting, and an adjustable screen with a soothing color can go only so far in eliminating the stress, visual strain, and fatigue from seven

or eight hours a day at a VDT, performing repetitive tasks done at the machine's pace.

Nationwide standards may be necessary to protect workers from the long hours that lead to chronic health problems. The following guidelines should be considered:

The NIOSH recommendations that operators be allowed a 15 minute break for evey two hours of work on a VDT when engaged in tasks of low visual damand, and a 15 minute break every hour when the visual demands or repetitiveness of a task are high (such as key-punching, or scrolling a screen to review, search, or edit material). These breaks would be used to perform other tasks unrelated to the VDT.

Limiting operators to spending only up to 50% of their workday on VDT work, with the other half spent on different tasks; this type of legislation is currently proposed in Norway and has been achieved in a number of labor contracts in Sweden.

16. STATEMENT OF THE AMERICAN SOCIETY OF TRAVEL AGENTS, INC. (ASTA)

ASTA is the world's largest trade association of professional travel agents, comprised of 12,000 travel agent members throughout the United States, and a total worldwide membership of agents and industry suppliers exceeding 20,000. ASTA's purpose is the promotion and advancement of the interests of the travel agency industry and the safeguarding of the traveling public against fraud, misrepresentation and other unethical practices.

It is estimated that 85 percent of the nearly 24,000 travel agencies in this country are automated. The computerization of this industry that is 90 percent small business has increased efficiency and better service to the consumer as well as significantly increasing sales volume.

Recent investigation by the government and medical community into the safety and health of video display terminals (VDTs) is a concern to the travel agency industry. Legislation, with varying degrees of provisions, has been introduced in 13 states to regulate the use of VDTs. ASTA believes that since research and development will continue without legislation, the educational approach will be more beneficial to the manufacturer, manager and user. Forcing uniform regulations on the use of video display terminals is confusing at best since this equipment is used for such diverse purposes and in different settings.

Office relationships cannot be legislated. In fact, it could cause disruption. This would especially be a problem for small businesses who do not have the resources to reequip or alternate jobs for employees The requirements in one particular situation may differ considerably from another. Freedom and limitations to the operator would be difficult with definite criteria in legislation. Hostility could arise from strict definitions of workplace behavior when they may be inappproprate for many situations. Good employee relations should be encouraged through sound management practices in the education of VDT use.

ASTA believes that the current documented research from the diverse disciplines of ophthalmology, gynecology, radiology, psy-

chology, ergonomics etc. has yet to produce solid evidence for VDT legislation. At present, the correlation between VDT use and health and safety is weak, though we encourage continued study into comfort factors. At this time, ASTA believes that legislation is inappropriate for this issue. Unlike other VDT professions, travel agents are not confined exclusively to the terminal. Their VDT usage is naturally broken up by client contact and phone usage.

17. STATEMENT OF THE COALITION FOR WORKPLACE TECHNOLOGY

The Coalition for Workplace Technology is an organization of diverse trade and professional associations that have joined together to develop solutions on broadly-shared problems. Their members use and manufacture computer-based equipment to improve national and international competitiveness, raise the quality of products and increase the effectiveness of organizations.

The Coalition's mission is to educate members, their member companies and the public about issues surrounding the introduction of new technology in the workplace. To accomplish this, its members have fostered training programs within individual companies. The Coalition is also training individuals to deliver education modules to visual display managers within the general public. It works with the national media to distribute information about new technology and to clarify claims and accusations. And through these effective programs, the Coalition is helping visual display users gain full benefit from new technology.

The Coalition also analyzes proposed state and national legislation dealing with the introduction of new technology and supports or opposes it, as appropriate. In the past year, we have concentrated almost exclusively on legislation or regulation to restrict the use of visual displays at the state level, legislation we have strongly opposed.

The Coalition has followed carefully the Subcommittee's hearings on visual displays. While we were initially alarmed at a number of irresponsible and inaccurate statements given before the Subcommittee by proponents of legislation, we are satisfied that subsequent representatives from the scientific, medical, academic and business communities have set the record straight.

There is no health or safety danger connected with the use of visual displays.

Physical discomforts experienced by visual display users are similar to the discomforts of individuals doing similar tasks without visual displays. Education does not remove the need for employers to invest in adequate furniture, good lighting and a generally comfortable work environment.

Many complaints associated with visual displays arise from different reactions to organizational culture, work structure and management style.

Because it is new, the visual display has become the lightning rod for many complaints that office workers have long had about their jobs.

Legislation to restrict the use of visual displays is inappropriate.

18. STATEMENT OF THE METAL TRADES DEPARTMENT, AFL-CIO

At our Metal Trades Department convention in September, 1983, a resolution was presented on VDTs by the Office and Professional Employees International Union, one of the twenty-one unions making up the Department. It called for a series of remedial actions to help provide some minimal safeguards to workers assigned to VDT jobs and was unanimously adopted by the delegates at the convention.

RESOLUTION No. 10

Submitted by the Office and Professional Employees International Union.

VIDEO DISPLAY TERMINALS

Resolved, That this Metal Trades Department convention express its deep concern about the health problems that are inherent in the operation of VDTs and CRTs; and be it further

Resolved, That the MTD and its affiliates take every action to establish and support programs to provide a continuous and on-going study for the monitoring of these video display terminals and for obtaining adequate occupational safety and health protection for personnel operating these machines; and be it further

Resolved, That the MTD and its affiliates whose members operate this equipment insist on these minimal safeguards in their collective bargaining agreements:

1. Regular breaks for persons working on VDTs.
2. Eye examinations for persons before they first go to work on VDTs and periodically (yearly) thereafter.
3. Detached and adjustable keyboards and screens on the machines.
4. Room lighting adjusted and controlled, the machines and their operators' positions arranged and other steps taken to minimize glare and associated visual acuity problems.
5. Careful attention to operators' chairs, with the height of the seat and backrest adjustable, and they should have armrests.
6. VDTs should be tested for radiation emissions and proper functioning at regular intervals.
7. Transfer of pregnant workers, upon their request, to non-VDT work during their period of pregnancy with no loss in pay; and be it finally

Resolved, That the MTD and its affiliates work strenuously for federal and state legislation embodying this same health protection, since no member should be required to trade wages and fringes in bargaining for a safe and healthy work environment

19. STATEMENT OF THE OFFICE AND PROFESSIONAL EMPLOYEES INTERNATIONAL UNION, AFL-CIO

The Office and Professional Employees International Union, AFL-CIO, represents 140,000 white collar workers throughout private industry—insurance, universities, utilities, shipping, manufacturing, hospitals, hotels, etc.

Approximately five years ago our members who operate video display terminals began to complain of eyestrain, visual fatigue, headaches, dizziness, nausea, body aches and pains, and those complaints have continued unabated. More and more members report frequent eyeglass prescription changes or initial purchases of glasses Many report difficulty focusing and, therefore, driving after working hours.

We became concerned with the number of complaints and, therefore, with the Newspaper Guild requested that the National Institute on Occupational Safety and Health conduct a survey of VDT operators in San Francisco to confirm or refute the problems. NIOSH, in fact, confirmed high levels of visual, musculoskeletal and mental stress.

In a survey we later conducted among our members who work more than 4 hours each day at the machines, more than 50 percent reported visual problems, frequent headaches and neck aches, shoulder and leg pains, tension and fatigue. The survey confirmed the NIOSH report.

There are no panaceas for removing the causes of worker alienation for VDT operators any more than such panaceas may be easily developed for other workers. The type of work frequently involved is inherently monotonous, boring and thus stressful. What can be done is to rearrange the work environment and design the machines so as to reduce the extraneous stress which cumulatively contributes to fatigue. There appear to be certain fundamental points which stand out in the literature as vital to the development of a more ergonomically satisfactory work environment:

(1) All workers employed in manning video display terminals should be subject to regular eye exams. These eye exams should occur prior to work on the terminal and on a regular basis (yearly) thereafter. These eye tests should be done at the place of work during the normal work day. so as to reflect the effects of the normal workload on the eye. And, they should be at employer expense.

(2) Ordinary glasses for private use are often unadjusted to the visual distance occurring in display screen work. Traditional bifocal lenses are unsuitable in many cases, because they often entail a strenuous work posture when used for display screen reading.

(3) All VDT operators should have regular, fixed work breaks away from the display unit. We recommend 15 minutes for every hour on the terminal or 30 minutes every two hours. And, we recommend a maximum limit of five hours work on the machine daily. All operators should be allowed work other than VDT work 30 minutes prior to quitting time.

The 30-minute break time at the end of the day should be provided in order to allow the workers' eyes to readjust before they attempt activities such as driving home.

(4) Tests should be made to ascertain glare and reflection on the display screen and to remove this glare or reflection by either moving the work station or installing anti-glare screens in sufficient quantity as to remove these stressors.

(5) Levels of flicker below 60 Herz are unacceptable and, as new terminals are introduced into the workplace, they must be required to have a regeneration rate over this fatigue.

Flicker is that phenomenom which occurs when the phosphor which produces the characters is not refreshed frequently enough, causing the letters/characters to shimmer.

(6) Ambient lighting in areas in which video display terminals are used should not exceed 300 lux.

(7) Excessive difference of luminance in the field of vision produce what is termed contrast glare. The workplace should therefore be organized in such a way that the background display screen is of suitable luminance and the employee's field of vision does not include a window or any other glaring luminances. Bright reflections in the display screen are to be avoided.

(8) The visual distance to the display screen and the angle of inclination of the screen should be individually adjustable with due regard being paid to other ergonomic requirements.

(9) The design of the work station should be sufficiently large so as to give the worker sufficient room to spread out materials necessary for work and to develop a comfortable work posture in the different modes of activity.

(10) The equipment on which the display is shown should be kept in a good state of repair as should the data displayed. A frequent complaint is work tubes getting blurry at the edges. Clearly a regular maintenance program is to the employer's advantage as well as the employee's.

(11) Up to this point we have not mentioned the potential radiation hazards from the machines. Clearly the evidence is in that the vast majority do not emit radiation above the U.S. standards, although many emit low levels of radiation. Scientists disagree over the long-term effects of exposure to low-level radiation.

We take the position that it is far better to protect workers from potential or perceived risks until science clearly proves there are no hazards, rather than the reverse. We, therefore, propose that pregnant workers, at their request, be transferred to jobs away from the terminals for the period of their pregnancies at no loss in pay.

In the meantime, I would also strongly urge further research on radiation hazards posed by VDTs, as well as general research on the effects of longtime exposure to low level radiation.

Each of these proposals has been adopted in countries like Sweden, Germany, Britain, Canada—either through contract negotiations or through legislation. Our own State of Wisconsin has adopted a few of them for the state government. Several other states are considering them now. OPEIU and other trade unions have negotiated them into contracts across the country.

In general, we are only asking that the fundamentals of good ergonomic principles be applied. And, many machines are on the market which contain the design features we have outlined. Ergonomically sound furniture and lighting is available as well.

Through collective bargaining we will continue to strive to make new breakthroughs in the health and safety of our members. But,

the fact is that no worker in this country should be forced to trade wages and fringe benefits for a safe and healthy work environment. Safety and health should be guaranteed by the law and by their employers.

APPENDIX B

VIDEO DISPLAY TERMINALS AND ELF/VLF ELECTROMAGNETIC FIELDS

There are groups that believe the VDT is a source of radiation possibly harmful to the health of the user. Many reports and scientific studies have discounted these claims through demonstrations that visual and ionizing radiation and the non-ionizing (NEMF) electromagnetic fields emitted by the VDT are far below accepted safe levels. However, NEMF levels measured very near VDTs are claimed by some researchers to be as high as the thresholds for some reported biological effects albeit not necessarily adverse effects. Allegations have been made that the radiation from the VDTs will cause reproductive problems. It is the purpose of this note to comment on and summarize the findings of available literature and studies that pertain to the problem.

Most of the emphasis of the previous studies and surveys has been to relate the strengths of the emitted NEMF from the VDTs to reported biological effects. Very little attention, however, has been directed toward the dosimetry aspects of the problem; i.e. quantifying the actual induced currents and absorbed energy in persons operating the devices.

It is important to account for the highly localized near field nature of the emissions, the poor coupling of the energy to the body of the VDT user, and the relationship of the absorbed energy in the body to that known to be of a biological significance as determined from research with animals and various biological preparations. It is important to: 1) determine the mechanisms for transfer of the NEMF energy to the biosystem; 2) determine the effects of NEMF energy on living systems; 3) determine the dependency of effects on various NEMF parameters such as field strength, modulation, frequency, etc.; 4) discuss the measurement problems and techniques for quantitation of the NEMF emissions and their effects.

The 60Hz fields are not unique to VDTs and often occur at much higher levels in other domestic or office devices. The VLF fields from VDTs have high peak values compared with their average levels but the rms (root mean square/average) values are critical since national and international safety exposure standards, based on known effects, are expressed in terms of those values.

NEMF emissions from VDTs may be measured with the use of two basic approaches. The first involves quantitation of the fields in the frequency domain by tuneable narrow band field strength meters and spectrum analyzers. The second and perhaps more efficient method is to measure the fields in the time domain in terms of average or rms values by broad band voltmeters connected to appropriate field sensors. There are major problems with both approaches and all values obtained need to be evaluated as to validity in terms of the measurement condition. Most of the instruments

(71)

fail in one way or another in quantifying the fields that exist under actual exposure conditions.

ELF EMISSIONS

Stuchly, et al., (1) has provided the most complete information available on ELF emissions from VDTs using a small ferrite loaded loop antenna connected to a low frequency analyser. The authors measured the strengths of the magnetic field emissions from various VDTs at 60Hz and its harmonics up to 420Hz. These levels are well below or similar to other commonly used devices.

Harvey, et al., (2) has measured ELF emissions as part of comprehensive study.

Weiss and Peterson, (3) measured the NEMF emission from a number of units used by AT&T. Cox, (4) reported a number of measurements made by the British National Radiation Protection Board. Zuk, et al., (5) (Radiation Protection Bureau of Canada) investigated VDTs in the frequency range 10kHz—220 MHz. Harvey (2) measured VLF field strengths and ELF, and d.c. levels. Some of the earliest work on VDT emissions was done by the United States National Institute of Occupational Safety and Health (NIOSH) in 1975 with the results published by Moss, et al. (6). The NEMF levels were not detectable in these studies. Wolbarsht, et al., (7) published data for the integrated rms electric and magnetic fields intensities at 25 cm from the CRT face and compared the results with those from color and black and white TVs.

Exposures in the range of 60 Hz through 200 kHz, (the frequency range of the small amounts of VDT NEMF emissions) result in relatively low amounts of absorbed energy for exposures of the human body to even the highest fields in the environment of the VDT.

The only known undisputed mechanisms of intersection of NEMF energy in the frequency range of 60 Hz through 200 kHz with biological systems are: a) electric shock, b) spark discharge, c) elevation of tissue temperature, and d) burns. The exposure fields required to produce effects by these mechanisms are far above those emitted by VDTs. Those fields that have been reported to produce bone growth or teratologic changes have time domain wave shapes that are not produced by VDTs.

In conclusion, there is no known mechanism for any of the effects that have been reported for levels of electric and magnetic field exposure at levels and frequencies corresponding to VDT emissions.

Some quotations:

Stuchly, et al. (Radiation Protection Bureau of Canada) (1).

ELF

Our measurements indicate that VDTs emit ELF electromagnetic radiation which are at least about 1000 times less than the magnetic-flux densities that were shown to cause potentially hazardous biological effects. The frequencies of VDT emissions are such that low-intensity effects such as demonstrated in bone healing, calcium efflux and behavioral studies are not likely to apply in this case.

In conclusion, the electromagentic emissions at ELF from VDTs are of such low intensities that on the basis of the available scien-

tific data they are extremely unlikely to be of any health significance.

VLF

The biophysical interaction mechanisms of radiofrequency fields with tissues were recently evaluated to establish the lower threshold values of the field intensities which may potentially have a direct influence on the central nervous system. The electric field intensities to which operators of VDTs may be exposed are at least one thousand times lower than these thresholds and the highly localized fields are at least 10 times less. Furthermore, the localized fields are not capable of deep penetration.

No other frequency or intensity specific biological interactions have been anticipated for the radiofrequency fields in the frequency and intensity range associated with VDTs.

Harvey, et al. (Ontario Hydro) (2).

SUMMARY

1. Operator exposures to radiofrequency electric fields are two or three orders of magnitude less than the MOL and ACGIH guideline levels.
2. The assessment of possible health hazards by "interpolation between higher and lower frequencies" suggests that there is less risk from VDUs than from the general electromagnetic environment in populated areas.
3. Available information on the biological effects of electric fields does not reveal any cause for concern about VDU emissions.

ELF/VLF

Although many measurements have been made of the electric fields produced by video display units, there seems to be little agreement as to the meaning of the measurements in terms of actual human exposure. In the long term, it is human exposure defined in terms of time and some appropriate field variable or variables that will determine whether or not the fields are hazardous A simple interpolation suggests that a VDU work station may actually be one of the safer places to work.

MAGNETIC FIELDS

The measurements made in this study show that no VDU operator will be exposed to low-frequency magnetic fields in excess of any known occupational health and safety standards

In the frequency range from 10Hz to 1 MHz, no fields having characteristics presently known or suspected of being detrimental to human health were found.

BIOLOGICAL

Biologically equivalent environmental electric and magnetic fields have been estimated from measurements of the local fields produced by VDUs at 54 different Ontario Hydro work stations. These fields may be compared to other electric or magnetic fields in the environment or used to evaluate occupational exposures.

The occupational exposures for all of the surveyed units are found to be too low to be associated with any known health risk.

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* Radiation and VDTs A report by the Connecticut Academy of Science and Engineering

* Copies herewith

APPENDIX C

A Critical Review of Human Factors Standards for Visual Display Units (VDU's)

(Martin Helander Canyon Research Group, Inc. Westlake Village, CA 91361)

ABSTRACT

This paper reviews ergonomic standards for visual display units and some of the underlying source documents. The following design factors are reviewed: work station luminance levels, luminance distribution of work station, preferred color of lettering, multicolors or color contrast, image polarity, symbol contrast, symbol luminance, viewing distance, character format, character size, refresh rates, line separation, character and word separation, glare control, screen angle, screen location, display surface adustability, detachable keyboard, keyboard slope, keyboard thickness, key force, key travel, key spacing, keytop dimensions.

Research is necessary both to verify or reject some of the standards and to investigate the nature of visual fatigue. Some examples of high priority research are given.

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TABLE 1 —ANTHROPOMETRIC DESIGN OF WORK STATION

Item	Tech Univ of Berlin	German DIN 66234	Canadian DCIEM	VDT Manual	US mil sto 14728	Apex
1 Work station surface, height, width depth	Height-720 mm for fixed height 650 to 750 mm for adjustable	Height-max 720 mm for fixed surfaces 650 to 750 mm range for adjustable surfaces Width, min 1200 mm (600 mm for documents) Depth 900 mm		Height-720 to	Height, 740 to 790 mm, width—760 mm, min depth—400 mm min	
2 Work station knee room height width depth	Height-690 mm	Height, 660 mm min, 690 mm width-1200 mm min		Height, width, 800 mm, depth, 700 mm	Height—640 mm min width—510 mm min depth—460 mm min	
3 Home row height (from floor)	720 to 750 mm				720-750 mm	700 mm or less from floor
4 Keyboard thickeness	If more than 30 mm in height the keyboard should be recessed in work surface	Home row 30 mm or less above work surface		50 mm maximum, 30 mm preferred		
5 Detachable keyboard	Preferred Not required for compact units used according to original purpose	Preferred for clerical work Fixed keyboard may be suitable for some types of work				
6 Keyboard slope	< 5			5 to 15° with a 50 mm space for a palm rest	15 to 25 16-17 preferred	

TABLE 1 —ANTHROPOMETRIC DESIGN OF WORK STATION—Continued

Item	Tech Univ of Berlin	German DIN 66234	Canadian DCIEM	VDT Manual	US mil sto 1472c	Apex
7 Minimum design viewing distance	50 cm	50 to 80 cm 50 cm required if source document or keyboard is used	70 cm max	410 mm min for prolonged viewing (16 in) as near as 250 mm for brief viewing (10 in)		

TABLE 2 —DISPLAY PACKAGING CHARACTERISTICS

Item	Tech Univ of Berlin	German DIN 66234	University of London	Canadian DCIEM	VDT Manual	US mil std 14728	Swedish MDDSN	Apex	tuc
1 Tiltable display		If tiltable then no more than 5° forward or more than 20° backward			Yes		Yes		
2 Screen angle	Vertical	Vertical if not tiltable		Within ± 5° of plane normal to line of sight	Approximately vertical if not tiltable	No less than 45° from line of sight	Adjustable	Adjustable	Adjustable
3 Screen location	Top line below eye height Screen centered on a line 20° from horizontal	Upper edge of of display within 37 to 52 cm above work surface	A distance or optical correction that would require 2/3 or less of range of accommodation to be used for sustained viewing	Center of 10° to 20° below observers eye position	Upper edge of screen below eye height	150 to 1200 mm above sitting surface	visual distance to screen individually adjustable	30 to 45° below upright eye height	
4 Screen size				16 rows of 64 characters min					

TABLE 3 —DESIGN OF KEYS

Item	Tech Univ of Berlin	German Din 66234	Canadian DCIEM	VDT manual	U S mil std 14728	Apex
1 Keystroke	Tactile preferred to acoustic			Audible, tactile, or snap action		
2 Key force	260 to 1 5 N			25 to 1 5N	1N–4N max, for numeric 250 μN–1 5N for alphanumeric	25–150 gms

4 Key spacing	20 mm centers			18 to 20 mm centers	6.4 mm min between adjacent keytops	3–6 mm
5 Key surface	Matte	Dark symbols on a light background	Concave, matte			
6 Keytop dimension (top surface)	13 mm			12 to 15 mm	10 mm min, 13 mm preferred, 14 mm max	12.5 mm square
7 Keyboard layout	Calculator format for numeric pad	If significant numeric input then a numeric pad, locatable right or left, should be added		Telephone format for numeric pad	Embedded numeric cluster for volume input (if lower case not required)	

TABLE 4.—DISPLAY IMAGE CHARACTERISTICS

Item	Tech. Univ. of Berlin	German Din 66234	University of London	Canadian DCLM	VDT manual	U.S. mil std 14728	Apex	TUC
1 Phosphor	P31, P4		Medium persistance	Short (P31 or P4)	P31 and P4 generally is best			
2 Polarity	Positive preferred					Positive or negative for high ambients Negative for low ambients	Negative	Negative
3 Distortions		Vertical distortion <2% of width Horizontal distortion >2% of height Jitter <0.05% of diagonal						
4 Refresh rate	Flicker free	50 Hz actual for negative display Hz actual for positive display	24 frames per second for nominal ambients	60 frames (not fields) per sec (for interlace 2 fields equal one frame)	50 to 60 Hz		50 Hz for medium persistence phospors	50 60 Hz
5 Preferred color	Yellow green	Green through orange		Green or white only	Personal preference			Yellow green

TABLE 4 —DISPLAY IMAGE CHARACTERISTICS—Continued

Item	Tech, Univ of Berlin	German Din 66234	University of London	Canadian DOE M	VDT manual	US mil std 14728	Apex	TUC
7 Multi-colors or color contrast	Image should not be different color than the background	Color contrast may be used				Colored symbols on a background of a different color but equal luminance shall not be used		

TABLE 5 —DESIGN OF DISPLAY CHARACTERS

Item	Tech Univ of Berlin	German Din 662 4	University of London	Canadian Dcrem	VDT manual	US mil std 14728	Apex	TUC
1 Character format	Vertical	5x7 min with a width of 50 to 70% of character height	Increasing from 5x7 to 12x18 dramatically improves readability	5x7 min	5x7 min 7x9 or greater preferred with width 70 to 80% of height		Min 5x7 or 7x9	Min 5x7 or 7x9
2 Character size	16 min of arc min 20 min of arc pref	18 min of arc min 2 6 mm minimum	3 1 mm to 4 2 mm at a viewing distance of 700 mm	3 5 mm min	15 to 20 min of 3 1 to 4 2 mm	20 minutes of arc minimum and 10 roster lines for CRT 15 minutes of arc minimum for other types of display	1/200 of viewing distance for focus Min 3 1 to 4 2 mm height	
3 Percent active area (dot size/dot spacing)	The dots of a character should merge to create the impression of a line			75%				

5 Between character word spacing	Characters should be separated enough so that when set at full the space between them is 5% or less of symbol luminance	One dot position or 10% of character height	1/2 character width between characters (for upper case)	20 to 50% of character height		1/2 character height between words	
6 Blink rate				2 to 4 Hz	3 to 5 Hz with about equal on/off periods		

TABLE 6 —LIGHTING AND REFLECTANCE

Item	Tech Univ of Berlin	Germand Din 66234	University of London	Canadian DCIEM	VDT manual	U S mil std 14728	Swedish MBOSH	Apex	Tuc
1 Work station luminance levels	500 lx	300 lx to 500 lx for work stations with negative image displays 500 lx or more for positive image displays	500 to 750 lx	807 to 1076 lx (75 to 100 ftc)	300 to 500 lx	Consistent for other visual tasks 1075 lx recommended, 540 lx min for general office tasks	200 to 300 lx ambient supplementary lighting when required	300 to 500 lx	
2 Luminance distribution at the work station	Screen should have as high as possible luminance keyboard reflectivity between 4 and 6 Work surface reflectance not more than 6, preferably about 4	Max 3 1 between task surface and immediate surround Max 10 1 between task and periphery			Contrast ratio between screen background and other items in the working field within 1 10 acceptable, 1 3 to 1 5 preferred	Surfaces immediately adjacent to screen shall be 10% to 100% of screen background luminance and have a matte finish		Contrast ratio between screen and surround less than 10 1	

TABLE 6 —LIGHTING AND REFLECTANCE--Continued

Item	Tech Univ of Berlin	Germand Din 66234	University of London	Canadian DCL 4	VDT manual	U S mil std 14728	Swedish MBOSH	Apex	Tuc
3 Glare controle of display	Focusable reflections be avoided Coated tubes preferred over uncoated (diffusing coatings)	May be accomplished by Diffusing surface Micromesh filters Thin film optical coat gs Sprays Hood Combination filters		Anti-reflecive treatment a minimum	Order or preference 1 Thin film 2 Etching 3 Polarization filter with anti glare treatment 4 Micromesh filter 5 Polarization filter	Reflections that reduce information transfer are to be avoided	Bright reflections from screen are to be avoided	Glare index of 16 or less	
4 Symbol luminance				85 cd/m² (25 ft L)	45 cd/m² min 80 to 160 cd/m² preferred				
5 Symbol contrast	500% to 1000% with a background of 20 cd/m²	3 1 min 3 1 to 10 1 preferred 15 1 max with a background luminance of 10 cd/m² or more		4 1 in an ambient of 807% to 1076 lx (75 to 100 ft c)	3 1 min 8 1 to 10 1 optimal (background luminance be 15 and 20 cd/m²)	0 75 $(L_H-L_L)/LH$			3 1 to 5 1
6 Adjustments/ controls	Adjustable character luminance Adjustable background luminance			Symbol luminance	Adjustable character luminance Adjustable background luminance				

APPENDIX D

TEST FOR RADIATION CONDUCTED BEFORE THE SUBCOMMITTEE BY THE AMERICAN NEWSPAPER PUBLISHERS ASSOCIATION

Mr. NEERGAARD. Thank you. My name is Richard Neergaard and I have three instruments today with which I am going to measure four types of radiation on the VDT itself and also in the room itself for background radiation.

Mr. GAYDOS. Could you give us a quick summary, sir, on your background and qualifications?

Mr. NEERGAARD. Yes, sir, I have a masters degree in industrial hygiene and I have worked for the American Newspaper Publishers Associations for 5 years since I got out of school. I had courses on radiation in graduate school and we have had an individual from MIT who came in and gave us a course on measuring radiation with VDT's.

Mr. GAYDOS. All right.

Any questions?

Mr. ERLENBORN. No.

Mr. NEERGAARD. The first instrument that I have here is an international light radiometer. I am going to use it to measure, first of all, ultraviolet radiation. It has a digital dial on the face and it will give you an indication and scientific notation.

I would like to move it over here closer to the terminal if I could.

We have here a reading of 0.02 times 10 to the minus 4, and that is going to be in watts per centimeter squared.

I have here a VDT which has a screen that is covered with characters that we put on there. They are letters which are filling up the screen, somewhat more crowded than you might normally see on a VDT screen.

In the field we have forms that we use to report the readings. One of the first readings we take is the screen face. We take a detector and place it right up against the screen face. If you look at it you can see it reading zero. This is for ultraviolet radiation. I can move it to other places on the screen face where there are more characters and again we are going to have zero.

Mr. ERLENBORN. Could you tell us, I have noticed the background radiation recording 0.006 which is now down to 001. What is the source of that background radiation?

Mr. NEERGAARD. This is ultraviolet and within the room you are going to have several sources of ultraviolet. One of them is the overhead florescent light fixtures. I point it up to the ceiling and we are getting a reading of 0.02, which is more than the screen face. The outside light from the Sun is a very strong ultraviolet emitter and if I were to go over to the windows which I will in the moment and hold it toward the Sun, you would get a higher reading.

I am pointing it now in the direction of the VDT screen and you see it is slightly higher than when I pointed it directly overhead. Part of the reason for this is that we have a little bit of load at this angle from the windows which is the external situation. We have very minor fluctuations here. We have got 0.02 at the present time and the detector is held at probably 2 feet from the screen face at about the level that the operators would be.

Mr. ERLENBORN. I would assume that that reading comes from the background radiation rather than the VDT.

Mr. NEERGAARD. That is correct.

Again if we hold it here we have a 0.03 stable reading at the operator position. When I go right to the screen it drops down to zero. That is as close as you are going to get to the screen surface and it means that the radiation that we are measuring with this instrument is not due to the VDT. It is due to the background radiation within the room.

If you would like I would be glad to go over to the window and get a higher reading.

That is ultraviolet radiation.

I have to change the instrument settings and detector in order to measure infrared which will be the next one.

Now we are going to have readings that are in scientific notations. Infrared is a little bit more active than the ultraviolet is. A lot of it is due to heat. We got a steady reading of about 2.32 times 10 to the minus 4, again watts per centimeter squared. That was a background reading.

When we go to the screen reading it is a little bit less. It is 2.03 times 10 to the minus 4. When we go to the screen face it drops down tremendously. We are down to 0.54 times 10 to the minus 4 and again there is some amount of—a very low amount of heat that is coming from the screen face, but it is less than the room burden that you would have from the fluorescent light fixtures in front of the windows within the room.

Are there any more questions concerning this one?

[No response.]

Mr. NEERGAARD. The next instrument that I have is known as a NARDA instrument. I am going to measure radio frequency radiation with this and it has a needle indicator on it and we are going to be using the bottom scale which is in amps per meter squared. It will be set on the most sensitive setting and the readings will be primarily in the zero range here.

I have to attach a probe to it.

Mr. GAYDOS. Let me interrupt you here. Are these materials and the tests that you are going through, is that what the association makes available to the participating newspapers?

Mr. CASHAU. That is correct.

Dr BROWN. Yes, sir.

Mr. GAYDOS. So you do this as a matter of course? Is that under your jurisdiction or responsibilities?

Mr. NEERGAARD. Yes, sir, on a given study two members of a staff will visit the newspaper and it really is a two-person job to operate the instruments and move around to the terminals. We test about 40 terminals per day and we do six different types of radiation measurements. I am going to demonstrate four of them.

Mr. GAYDOS. We are getting a short version, is that right, of what you do?

Mr. NEERGAARD. That is correct.

Mr. GAYDOS. And is that on a regular basis 5 days a week that you are dispatched out in the field to take care of these tests?

Mr. NEERGAARD. Well, we could go any day of the week. We get very few requests for this particular type of service. Again we send an information package to the newspapers when they initially ask the question about radiation and we suggest that they provide this information to their employees, let them read it so they can see what the status of the various studies are and what the findings have been, and then if they have questions we try to answer the employee questions and the final phase that someone is just still completely upset about it and the newspaper wants to take measurements while going to the field and taking the measurements on the terminals.

Mr. GAYDOS. The typical situation would unfold along these lines. There would be an employee complaint. The publisher or the employer would be somewhat concerned. He would contact the association and to belay any fears you would conduct this test, is that correct?

Mr. CASHAU. As a last resort.

Mr. GAYDOS. Roughly that is about what happens. You don't go without being invited in to different areas?

Mr. CASHAU. No, absolutely.

Mr. GAYDOS. Is there a charge for this service?

Mr. CASHAU. Yes, sir.

Mr. GAYDOS. Could I ask you how much?

Mr. NEERGAARD. It would be approximately $1,200 plus expenses for transportation and meals for a 1-day study.

Mr. GAYDOS. Regardless of the numbr of terminals?

Mr. NEERGAARD. That would be for testing 40 terminals.

Mr. GAYDOS. And that is $1,200?

Mr. NEERGAARD. Yes, sir.

Mr. GAYDOS. Have you had any contact with the manufacturer of this instrumentality here as to what they warrant, implied or otherwise, as to the performance and as to the safety of the instrumentality?

Mr. NEERGAARD. No; I have not.

Mr. CASHAU. Every manufacturer manufactures the VDT to a specification. The VDT cathode ray tube is manufactured to not exceed 0.5 milligrams per hour and it has been our experience that we don't get anything from those. We have measured almost all of the types of VDT's that are used in the newspaper business.

Not all of them, of course, because new ones are added every day, but so far we have not been able to measure any detectable radiation.

Mr. GAYDOS. In a typical year how many times would you be called out, a guesstimation?

Mr. NEERGAARD. This year we have not been required to go out a single time. In 1983 we went out four times I believe. We have been—total of 11 studies is what we have gone on.

Mr. GAYDOS. Do you upgrade your equipment, do you test the equipment or has it remained substantially the same over the last 4 years.

Mr. NEERGAARD. It has remained the same.

Mr. GAYDOS. Do you think there is a need for upgrading or a purpose for it or does the state of the art indicate you are still current?

Mr. NEERGAARD. The state of the art indicates we are still current. Also there has never been a study that has determined a radiation emission. If there were one that indicated a radiation emission and there was an instrument used which was different from ours we would purchase it.

Mr. GAYDOS. Have you ever found any kind of violation by your tests?

Mr. NEERGAARD. None.

Mr. GAYDOS. Any of the instrumentality leaking?

Mr. NEERGAARD. Not a single time.

Mr. GAYDOS. And that is how long, a period of 4 years?

Mr. NEERGAARD. Two years We began in 1982.

Mr. GAYDOS. Is it the intention that you will continue on?

Mr. CASHAU. Yes, sir. We will continue as long as our members request it. We have access to a number of studies. The newspaper business started testing as soon as they introduced the VDT's back in 1970. There were only 23 in the newspaper business at that time. Those particular VDT's were tested and the same VDT's were also tested 2 years later after being in use, and there was no radiation found.

Right now our business has about 50,000 in use and we have no evidence that there is any problem.

Mr. GAYDOS. Are you the only employed industrial hygienist with the association or do you have other people?

Mr. NEERGAARD. We have a staff of five. Three with degrees and two technicans that go in to the field and do studies plus George who does not go out as much as he used to.

Mr. GAYDOS. That is quite substantial for an association, comparing that with what we are experiencing nationwide. You have quite a substantial staff. I would like to make that a matter of record.

Mr. CASHAU. We also have a full-fledged laboratory and have a full-time chemist devoted to analyzing materials that are sent in to us such as inks and paper and industrial hygiene samples that the hygienists bring back from the field. So in addition to the five people that travel we also have several other people devoted to health and safety and analysis of the materials that we do use.

Mr. GAYDOS. Forgetting about the existence of a comparable activity such as you are now the head of in that department, your daily charge, is that reasonable or is it probably substantially less than you could probably experience if you were forced to seek in the private area like services?

Mr. NEERGAARD. It is substantially less than you would have from a private consultant firm. Some States maintain staffs who go out on the basis of someone requesting a study but as far as pay for services, we are less than most consultants would be.

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Mr. NEERGAARD. Again I would like to measure radio frequency radiation and I am going to use that nardameter [phonetic] which has a needle on the face of it. It will be somewhat more difficult to see and I would like to take a couple of background readings close to your desk in the front.

Mr. GAYDOS. We consider it quite an honor to have Mr. Erlenborn with us because as a senior Republican member he has other duties and does not often have an opportunity to make our meetings. It is a rather minor subcommittee compared to his other duties, so we are very happy to have him.

Mr. ERLENBORN. Thank you.

Mr. NEERGAARD. As you might imagine this red color when we go into the field attracts quite a bit of attention.

Again what I have here is a meter with a needle on it. We are going to be measuring on this bottom red scale and the way it is set up it will measure from 0 to 2.5 amps per meter square and I have to take it away from my body and zero it first. We have some needle drift with this. Amazingly enough the reading is zero.

Mr. GAYDOS. Is the committee being charged for this?

Mr. NEERGAARD. Yes, sir, we have a special fee.

Mr. GAYDOS. The President says he must have a tight budget. Here is the President's spokesman right next to me, so we have to be careful what we spend.

Mr. NEERGAARD. This particular instrument we take readings in seven positions around the VDT. We take it at a screen face, on both sides and the back, on top, beneath the desk and also at the operator position. The reason for this is we are trying to give wide coverage to the machine in any area that could possibly have an emission.

What I am doing is going over the surface of the screen with the probe and getting a zero. Then I go to the right side and again we are having a zero reading. This is all I ever get with this probe.

I will go to the back surface. Again we have a zero reading. To the left side, zero.

Mr. GAYDOS. I can see now why it takes so long to make a test, particularly if you are running it on 40 of them.

Mr. NEERGAARD. Yes, and the areas that we go to are such departments as classified. Each time you go in, you have employee questions and we try to answer the questions they have. They have natural questions about how the instrument works, and it takes time to respond to them.

We also have the top, and I will show you everything. This is zero. There is a ventilation slot in the back here which I am going to go over too, just to show you that it is not the case that is blocking this out. There is nothing there to measure.

Then we do beneath the desk, and that is zero. And lastly, the operator position is zero.

Mr. ERLENBORN. Have you ever used these instruments on a microwave oven?

Mr. NEERGAARD. I have one time, and I found zeros with that too. There are very rigid specifications because it is a microwave generator.

Mr. GAYDOS. Did you ever find a VDT that did leak anything resembling a dangerous level of anything?

Mr. NEERGAARD. No. We have never found any type of emission from a VDT for any of the six types that we evaluate them for.

Mr. GAYDOS. Have you ever heard of any leaking or certain tests being positive rather than negative, as yours are?

Mr. NEERGAARD. I have never heard of one being detected. There have been thousands of them checked and all the studies that I have ever seen have never shown an emission in any of the six areas that we are talking about. You would think with that many, if there was going to be some kind of a leakage problem, you would have seen it at least once, and it has never occurred.

Mr. GAYDOS. As an industrial hygienist, and maybe it is unfair to ask you, have you ever been exposed to credible evidence which would lead you, as a professional, to conclude that cataracts have resulted from using these instruments?

Mr. NEERGAARD. No.

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The last instrument that I am going to show you is a Victorene. This is an ionizing radiation meter. It would measure x rays and gamma rays. This meter is set up right now on the 1 scale, and I would like to bring it up here for a moment.

We have, on this, as you can see, detectable needle indication here. Its reading right now is about at 0.22, and this is millirims per hour. You see a little bit of a surge. This is a normal occurrence. We have some sources in the room, building materials, that contain radioactive elements, and they will give you emissions that cause some needle deflection here.

Again, the standard for this instrument is 2.35. This is set at 1 so the needle would have to be considerably off scale in order to have anything approaching the standard. With this instrument we would take background readings and for a room like this, perhaps 8 or 10. I don't want to do that here, but you can see at this spot we are having about a 0.23, and here we have about a 0.22.

We normally would take a series of background readings in the room and average them in order to find out what the average background is for this instrument.

The next step is to go over the terminal, such as we have here, begin with a screen face with characters on it, and we place the instrument flush up against the screen, and we have a 0.23 at this position. This reading is essentially the same as the background readings we were getting. And, again, we are well below the 2.5 standard that there is for this.

We would do the same thing on the side. We have a 0.22. That was the right side. We will just go ahead and skip to the left side here. It is a 0.21. We would do the top and the bottom also.

Now I could turn this terminal off and take the same measurements. I think you will see that there is no perceptible change in the needle indications that we have. The VDT has now been turned off, and we set the instrument up against the face, and we have a 0.23. On the right side we have a 0.22. On the left side we have a 0.23.

Again, I would like to stress that we would do this on both sides of the VDT on the back, on the top, the bottom of the table, and at

the operator position. That is what we would do for the ionizing radiation

I have something here that might interest you a little bit. It is kind of a brass ashtray with some ceramic porcelain that has been put on it, and it is colored. I would like to bring this up front here. This is what I am trying to tell you, but these trace radioactive elements. There are a few of them in some of the pigments on this ashtray. We put it in front of the window of this. it will cause the needle to go up considerably. It is over to 0 3 and still rising now. It is holding steady at about 0.39. Now it is going up higher, 0.42, 0.44. It goes up quite considerably. This is still well below the standard, and this is what I am trying to tell you about.

There are certain types of material that have higher levels of trade radioactive elements in it than others and some parts of the country have higher. That is the reason why we take background readings with this instrument, and that is the reason why these are factored out with this particular instrument when you are doing the studies.

Are there any questions?

[No response.]

Mr. CASHAU. That is the end of our presentation.

Mr. GAYDOS. I have one question, if I may. That terminal set there, if it were to emit some type of radiation, what would be the source of it in there? What would be malfunctioning in that terminal, if anything?

Mr. CASHAU. The glass shield.

Mr. NEERGAARD. If the glass shield were defective conceivably. I never heard of it happening.

Mr. GAYDOS. What about the covering around it? Should it be metal?

Mr. CASHAU. No. The cathode-ray tube itself is like a big vacuum tube. It is like a light bulb, if you will, and it is completely evacuated and contains the electron emitting source. The only way for it to get out would be through the glass some way, and if it broke or if there was a hole in it or something, it would fail.

Mr. GAYDOS. Well, we had experts before the committee that testified that the casing and the construction material was or were very important as far as containing any type of emission or radiation from it, not just the glass front, metal protection devices around the cabinet and things of that sort. That is why I asked the question.

Apparently, you are of the opinion that has nothing to do with it so we will just continue.

Mr. CASHAU. Well, not as far as ionizing radiation is concerned. Of course, as I said before, we are not manufacturers of the equipment.

Mr. GAYDOS. I understand.

Mr. NEERGAARD. I can only speak to what we have done in the field. We have measured VDT's with metal casings and plastic casings, and there is no difference between the readings we get. There have been none of them that ever have shown a radiation problem with any of the six types we evaluate. None of them have even been close to the standards.

I don't see any difference as far as what material you use to house the VDT as far as the levels that we get.

Mr. ERLENBORN. I would observe, Mr. Chairman, that that response makes sense since the radiation is directed to the front where there is no protective covering except the glass. It must be the glass that is the shield against that radiation.

Mr. GAYDOS. Well, I don't pretend to be an expert in any manner on this subject, but I am just referring to the fact that we have evidence before the committee to the contrary, and I just wondered if we could have another opinion on it to test the authenticity or acceptability. It is not that important.

Mr. NEERGAARD. What I might say is that this is not a metal-cased instrument. And we are getting no readings with it. If we had a metal casing, I don't think we are going to get any readings either. If there was going to be a worse case, this would be it.

Mr. GAYDOS. I have no further questions. . . .

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